Journal

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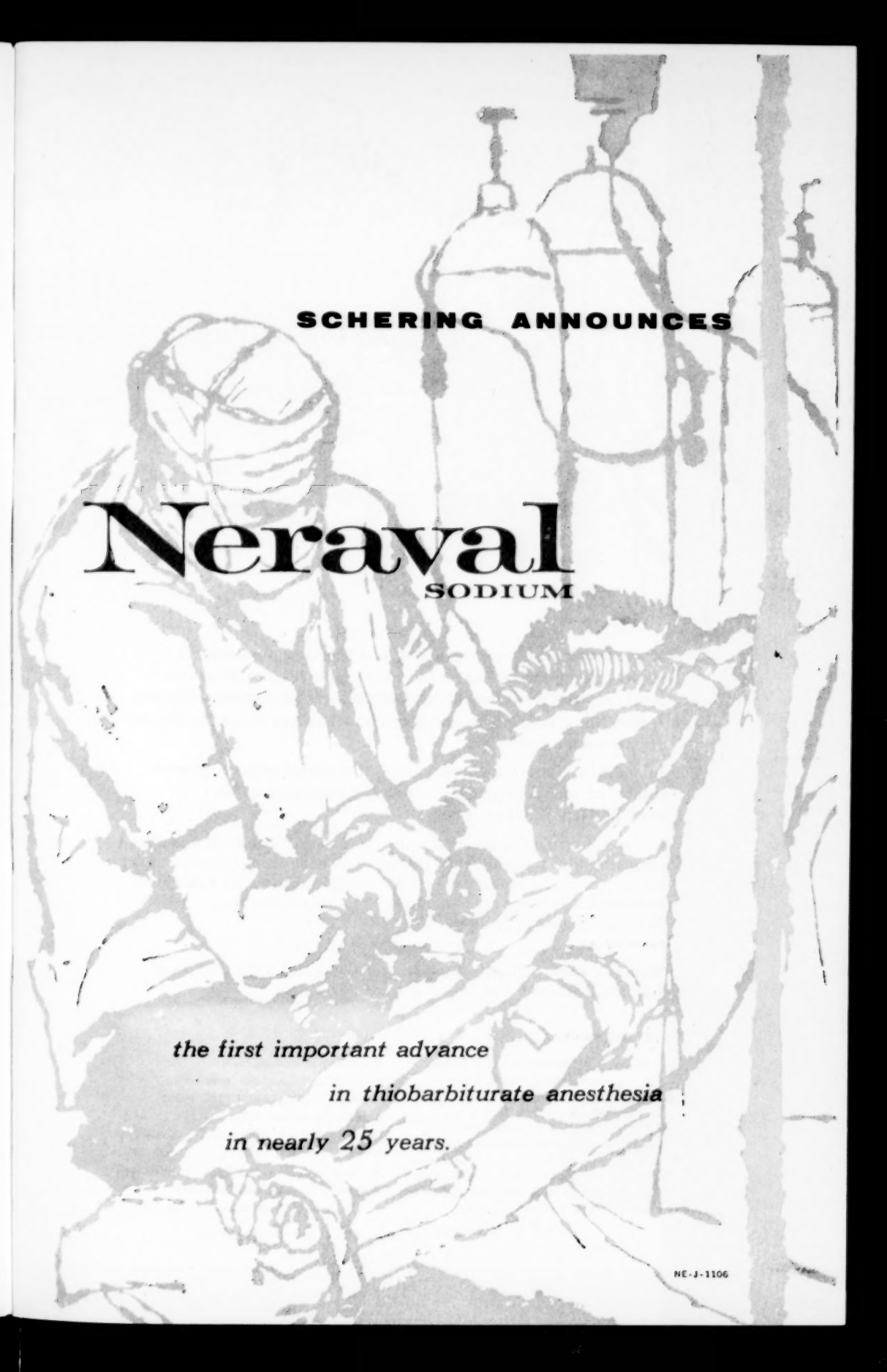
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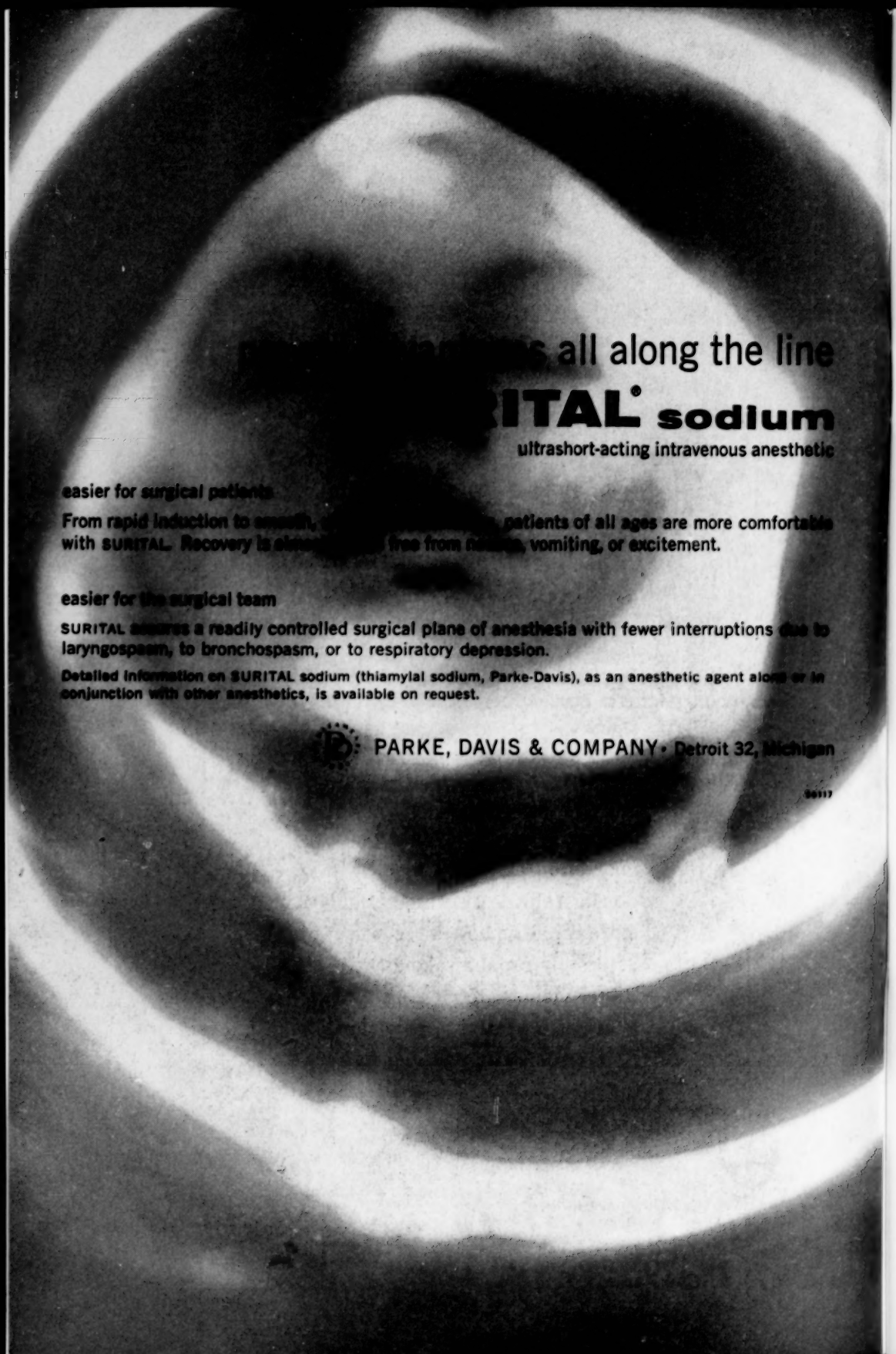
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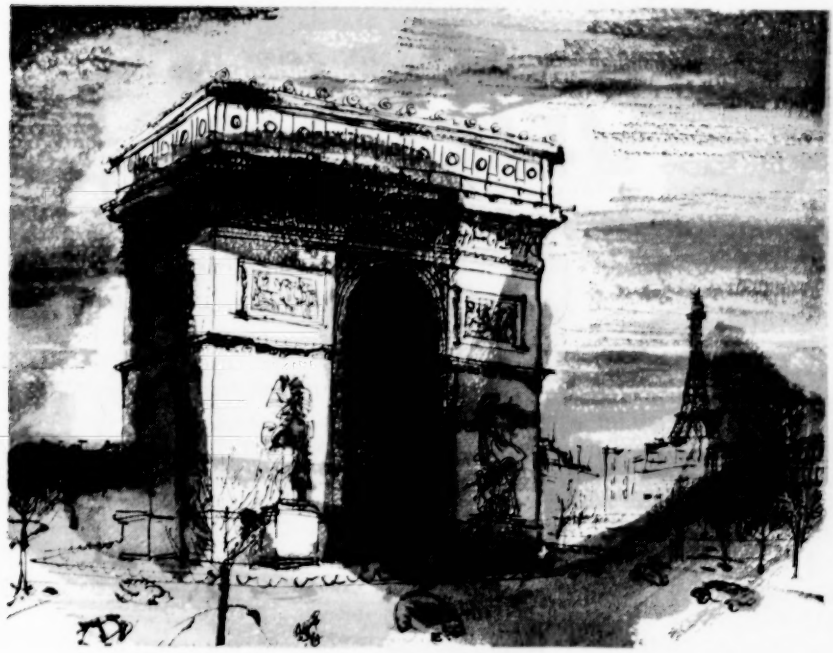

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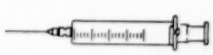

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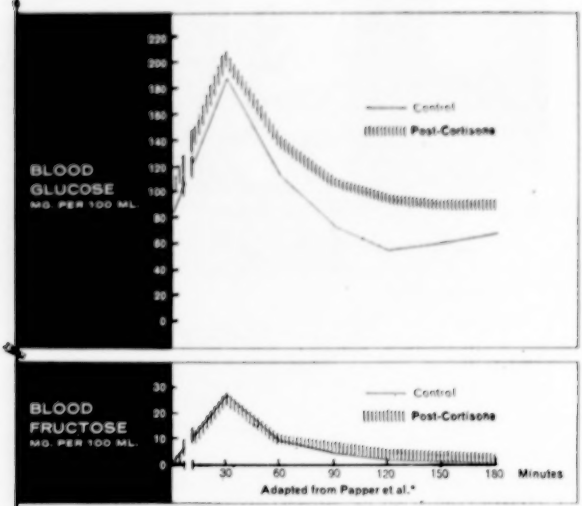

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**Papper, S.; Sazon, L.; Prout, T. E., and Alpert, H. C.: The Effects of Cortisone on the Fructose and Glucose Tolerance Tests of Normal Men, J. Lab. & Clin. Med. 48: 13 (July) 1956.*

Autonomic Cardiovascular Disturbances During Anesthesia

D. LeRoy Crandell, M.D. and W. G. Page, M.D.*
Winston-Salem, North Carolina

Abnormal function of the autonomic nervous system is frequently responsible for cardiovascular disturbances, reflex in nature, which occur during anesthesia and which are manifested by hypotension and an alteration in cardiac rate or rhythm. The autonomic nervous system serves as an important pathway through which reflex cardiovascular disturbances are mediated, hence a knowledge of the autonomic nervous system and its relationship to these cardiovascular disturbances is imperative in order that effective therapy can be employed.

The autonomic nervous system of the conscious person is constantly adjusting to or compensating for environmental stresses. This compensating capacity is diminished in the anesthetized patient and the anesthetist must assume the burden of maintaining the physiological stability of the compensatory mechanisms.

Imbalance between the parasympathetic and the sympathetic divisions of the autonomic nervous system rarely exists in the unanesthetized patient, while in the anesthetized patient, autonomic imbalance is the rule rather than the exception. The activity of the autonomic nervous system varies from person to person so that stimulation of the autonomic nervous system may produce pronounced cardiovascular disturbances in some, with minimal disturbances in others. Sensitive receptors and a favorable status of the reflex arc and effector organs are necessary to initiate maximum effect on the cardiovascular mechanism. Autonomic activity is further influenced by various drugs, premedicants, anesthetic agents and the location and the intensity of direct mechanical stimuli.

Each individual patient can be classified as sympathotonic or parasympathotonic according to which division is dominant. Excessive sympathetic activity is characterized by sinus tachycardia, excessive palmar perspiration, dilated pupils, occasional ventricular extrasystoles or a nonpersistent rise in blood pressure. Parasympathetic overactivity is seen in patients with bradycardia, sinus arrhythmia, obstructive jaundice, spastic colon or peptic ulcer. The individual autonomic imbalance of each surgical patient should be evaluated preoperatively.

Effect of Drugs

Special consideration should be given to the action of preoperative drug therapy on the autonomic nervous system. The increased usage of

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tranquilizing therapy for mental distress, anticholinergic therapy for gastric distress and antihypertensive therapy for hypertensive cardiovascular disease makes this necessary in order to properly evaluate the status of the autonomic nervous system.

The use of digitalis or quinidine may be required in the cardiac patient. The action of these drugs on the cardiac vagus is of importance. Digitalis by enhancing vagal tone will shorten the refractory period of auricular muscle and increase the transmission rate. Patients who are rapidly digitalized receive routine digitalizing doses with the result that a certain percentage of patients will be overdigitalized. Therefore the anesthetist should avoid the use of a parasympathomimetic agent such as cyclopropane in a patient who has been rapidly digitalized for fear of summation of vagal effects. Digitalis also increases the sensitivity of the carotid sinus and profound cardiovascular disturbances may result when stimulation of the carotid sinus occurs during thyroidectomy or radical neck dissection. Quinidine depresses or abolishes cardiac vagal tone and so lengthens the refractory period of the auricular muscle and decreases transmission rate. This action of quinidine upon the cardiac vagus is opposite to that of digitalis. Parenteral quinidine has proven to be effective in the treatment of cardiac arrhythmias due to reflex stimuli or direct mechanical stimulation of the cardiac muscle especially during cyclopropane anesthesia.

Premedication

After careful preoperative evaluation of the status of the autonomic nervous system together with a knowledge of the site of surgical stimulation, the selection of the proper premedicants and anesthetic agents may be achieved.

Premedication plays an important part in the anesthetic management. Of the belladonna derivatives, atropine is preferred in the parasympathotonic patient because of its greater vagal blocking action than scopolamine. Doses of atropine from 0.4 mgm to 0.6 mgm are used to insure adequate vagal blockade. Smaller doses should be used in the patient with coronary artery disease and poor cardiac reserve. The production of a decided tachycardia will result in a decrease in the duration of the diastolic phase of the cardiac cycle. It is during this phase that the coronary arteries fill. Smaller doses are also required in the presence of hyperpyrexia to avoid blockade of the compensatory sweating mechanism and thus enhancing heat retention. In glaucoma, the resultant dilatation of the pupil may obstruct drainage through the Canal of Schlemn and further increase intraocular pressure. Pilocarpine eye drops with decreased doses of atropine will obviate this complication.

Scopolamine is preferred to atropine in the sympathotonic patient because of its cortical depressant effect and lesser vagal blocking action. Scopolamine like atropine acts peripherally by blocking the cholinergic post-ganglionic autonomic nerve fibers. Centrally scopolamine has a dual action. While it has the advantage through its cortical depressant action of producing amnesia, it has the disadvantage of increasing vagal tone as a result of its central action. This has resulted in an increased frequency of reflex cardiovascular disturbances which have required the intravenous administration of atropine for their abolition. The phenothiazine derivatives chlorpromazine

and promethazine are also of value as premedicants in the sympathotonic patient because of their sympatholytic action. These drugs also potentiate barbiturates, narcotics, anesthetic agents and facilitate the production of hypothermia. In hypothermia they are of value in preventing sympathetic hyperactivity. Of the narcotic premedicants, it should be remembered that morphine and methadon have a cholinergic action and will tend to enhance vagal reflexes and the carotid sinus reflex. Demerol, however, has a mild atropine-like action.

Selection of Anesthesia

The anesthetic agent and technic also exert their effect. The somatic nervous system is depressed during general anesthesia. However, the autonomic nervous system remains active until profound metabolic depression is produced. Deep anesthetic planes should favor obtundation of autonomic reflex activity but the accompanying diminished respiratory tidal volume and depression of vital compensatory mechanisms is deliterious. Light anesthesia preserves these compensatory mechanisms and is essential to the physiological well being of the anesthetized patient. Cyclopropane and the thiobarbiturates are parasympathomimetic agents and will tend to enhance vagal tone. Parasympathetic reflexes are more apt to occur during the use of these agents. Ether, having a sympathomimetic action, will tend to enhance sympathetic reflexes such as that resulting from celiac plexus stimulation. The celiac plexus reflex under cyclopropane anesthesia and the carotid sinus reflex and vagal reflexes under ether anesthesia are of less frequency and severity. Nitrous oxide and ethylene have no autonomic action. Of the local anesthetic agents, cocaine alone possesses an autonomic action which is sympathomimetic in nature and is capable of potentiating adrenergic nerve stimulation and the action of epinephrine. The autonomic ganglionic blocking agents such as arfonad and hexamethonium are used for production of hypotensive anesthesia.

Some have recommended using curare to obtund or reduce the incidence of reflex cardiovascular disturbances during anesthesia. D-tubocurarine accomplishes this effect by autonomic ganglion blockade. The dose required is so large, however, that the undesirable effect of profound respiratory depression is produced. Flaxedil, on the other hand, does not block the autonomic ganglion but it does have a vagolytic effect.

Spinal anesthesia at a sufficient level to produce intercostal paralysis for upper abdominal surgery will produce sympathetic blockade and enhance vagal activity. This proves to be deliterious when one realizes that the vagal component of the parasympathetic division of the autonomic nervous system acts as a major pathway over which reflex cardiovascular disturbances are mediated and the sympathetic division serves as a vital compensatory mechanism. The sympatholytic action of spinal anesthesia is counteracted by the sympathomimetic amines such as ephedrine. Low spinal anesthesia for pelvic, perineal, and rectal surgery will produce sacral parasympathetic blockade and yet provide a sufficiently intact sympathetic system for compensatory purposes.

Anatomy and Physiology

A knowledge of the anatomy and physiology of the autonomic nervous

system is essential so that resultant reflex cardiovascular disturbances due to surgical stimulation receive the proper pharmacological therapy.

Head and Neck:—The oculocardiac reflex is produced by inadvertent pressure on the eyeballs from the anesthetic mask or head-rest during cranial surgery. This parasympathetic reflex resulting from stimulation of the opthalmic branch of the trigeminal nerve is manisfested by hypotension and bradycardia. The reflex is more marked during the administration of the thiobarbiturates and cyclopropane.

Stimulation of the respiratory tract may elicit profound reflex cardiovascular disturbances. These reflexes are parasympathetic in nature and are manifested by hypotension, bradycardia and arrhythmias. Pharyngeal reflexes from too early insertion of an oropharyngeal airway during the anesthetic induction are transmitted over the glossopharyngeal—vagal reflex circuit. Laryngeal and tracheal reflexes are elicted during tracheal intubation and inflation of the endotracheal cuff. Laryngotracheobronchial reflexes are mediated over a vagovagal reflex circuit. The carina is the most sensitive portion of the tracheobronchial tree. These reflexes can be prevented by blocking the afferent arc with adequate topical anesthesia or by blocking the efferent arc with atropine.

The carotid sinus normally serves as a cardiovascular compensatory mechanism which is directed towards the maintenance of a stable circulation. This reflex control of the circulation is so finely adjusted that one is often unaware of its function. Alteration in this normal function may occur during anesthesia and surgery. (Fig. 1)

The first portion of each internal carotid artery presents a bulbous dilation known as the carotid sinus. The wall of the sinus is richly supplied by sensory receptor nerves. These emerge from the sinus as the sinus nerve and ascend between the internal and external carotids to join the glossopharyngeal. Centrally the fibers end in the vasomotor, cardioinhibitory and respiratory centers in the medulla. The centrifugal part of the reflex arc is through the vagus nerve to the heart and through the sympathetics to the blood vessels.

There is a rhythmic discharge of nervous impulses over the sinus nerves, the rate of which is directly proportional to the pressure in the carotid sinus. Increasing pressure in the carotid sinus will increase the frequency of these impulses with a consequent slowing of the heart rate and peripheral vasodilatation. The resultant bradycardia and decreased venous return is responsible for the decreased cardiac output and marked fall in systolic pressure. The peripheral vasodilatation produces a decreased peripheral resistance and lesser fall in diastolic pressure, thus, there is a narrowing of the pulse pressure.

This reflex cardiovascular disturbance is frequently observed during a thyroidectomy or radical neck dissection. Arteriosclerotic changes and inflammation in the anterior triangle of the neck will increase its sensitivity. Certain drugs and anesthetic agents may also sensitize the carotid sinus. Among such are cyclopropane, morphine, digitalis, barbiturates and thiobarbiturates. Hypoxia resulting from poor alveolar ventilation will also enhance this reflex.

When the carotid sinus becomes hypersensitive, the reflex mechanism loses its fine adjustment. The effect

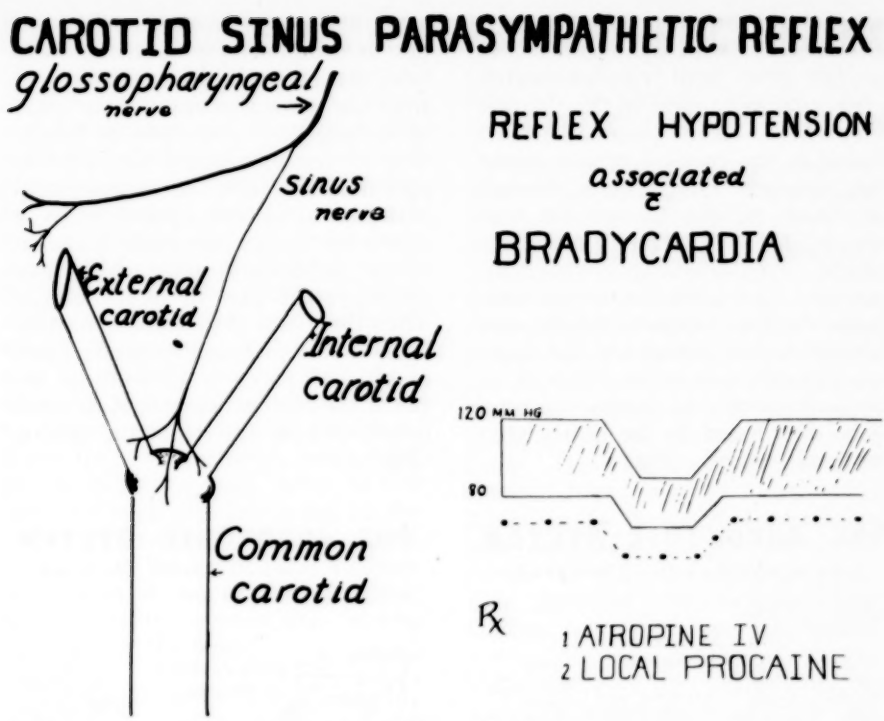


Figure 1

of mechanical stimulation during surgical manipulation is the production of profound cardiovascular disturbances. Important safeguards are adequate atropinization, avoidance of surgical stimulation and the maintenance of adequate alveolar ventilation. The reflex can be blocked with local procaine infiltration if necessary.

Thorax: — A knowledge of autonomic pathways over which reflex cardiovascular disturbances are mediated during intrathoracic surgery is imperative in order to employ techniques for their prevention. In general, the autonomic innervation of the lungs is almost identical with that of the heart. The pulmonary and cardiac plexuses are both composed of sympathetic and parasympathetic autonomic fibers. The cardiac plexus is located in proximity to the bifurcation of the trachea and origin of the great vesels at the base of the heart. The plexus is divided into a superficial and deep component. The right and left pulmonary plexuses are intimately joined with the cardiac plexus and are situated at the roots of the lungs in contact with primary bronchi and pulmonary vessels. The pulmonary plexuses are situated anterior and posterior to the hilum of the lung and are interconnected with each other unilaterally and bilaterally. The sympathetic preganglionic motor neurones originate from cells in the intermediolateral cell column in the first five thoracic segments of the spinal cord. They connect with the sympathetic chain ganglion by the white rami communicantes. The

ganglia of the sympathetic chain are connected with the spinal nerves by the gray rami communicantes. Some synapse at once in the thoracic sympathetic chain ganglion, others ascend to the cervical ganglia where they synapse. Others pass through the trunk ganglia to synapse with one of the collateral sympathetic ganglia. Sympathetic post-ganglionic neurones then leave the sympathetic chain via the superior, middle and inferior cardiac nerves and the upper five thoracic nerves to converge in the pulmonary and cardiac plexuses to be distributed to the heart, lungs and great vessels. (Fig. 2)

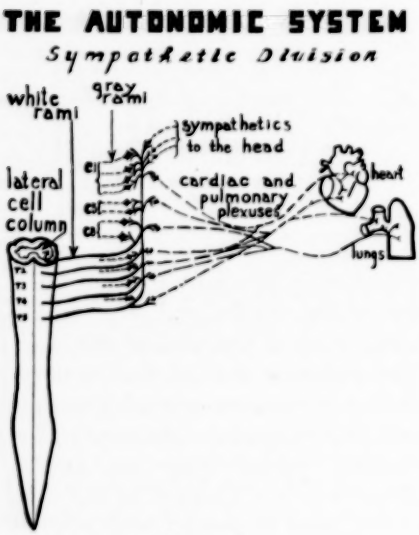


Figure 2

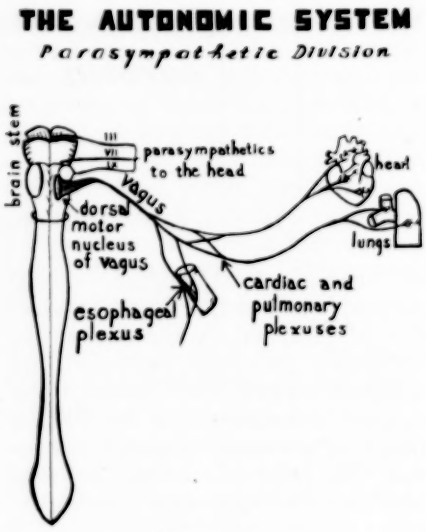


Figure 3

The parasympathetic preganglionic motor neurones originate from cells in the dorsal nucleus of the vagus. The preganglionic fibers then pass to the pulmonary, cardiac and esophageal plexuses, through which they pass to terminate in the intrinsic ganglia of their respective viscera. The esophageal plexus encircles the lower half of the esophagus. In addition to vagal fibers, sympathetic fibers from the upper thoracic ganglia and from the thoracic portion of the great splanchnic nerve enter into the formation of the esophageal plexus. The phrenic nerve also has anastomoses with the autonomic system when it enters the thorax and sends branches to the pulmonary hilus which play an important part in hilar reflexes. Thus there is a close interconnection between the pulmonary, cardiac, and esophageal plexuses as well as between the two components of th autonomic nervous system in the thorax. (Fig. 3)

There are numerous areas located in the thorax and thoracic viscera which, when stimulated during general anesthesia, are likely to produce reflex cardiovascular disturbances. These reflex disturbances are characterized by hypotension and alterations in the cardiac rate and rhythm. The most common operative maneu-

vers for initiation of such reflex disturbances are periosteal scraping of ribs, spreading of the ribs, pleural incision, manipulation of the hilus and pericardium and traction on the esophagus. Although of less frequent occurrence, serious cardiovascular reflex disturbances are also observed during ligation of the pulmonary artery and veins and clamping of the bronchus. The pathways over which reflex impulses are mediated are of importance. Reflex impulses may be mediated over afferent vagal fibers to the vagal center and then by efferent vagal fibers to the heart. Then too, reflex stimuli may reach the heart by an axon reflex in the vagal network without going to the center. Also vagal impulses which originate at the vagal nerve endings may, when it reaches the ganglion, transfer to the sympathetic system and then to the heart.

Intercostal nerve stimulation occasioned by periosteal rib scraping, direct intercostal nerve stimulation prior to rib resection and wide rib spreading by rib retractors, can be prevented by injection of local anesthetic agents in close proximity to the intercostal nerve above and below the incision. The inflamed pericardium and pleura are particularly sensitive and direct manipulation or incision may elicit profound cardiovascular disturbances. Operation near the thoracic portion of the vagus nerve as occurs during esophageal resection, exploration of the mediastinum and traction on the pulmonary hilus may lead to severe arrhythmias, hypotension, bradycardia and cardia asystole. The most sensitive portion of the vagus nerve is found to be at the heart and cephalad along its course. Ordinary mild stimuli may provoke decided cardiovascular disturbances. Routine injection of the hilus during pulmonary surgery and injection of vagus nerve directly during esophageal surgeary will reduce deliterious hilar and esophageal reflexes. (Figures 4-7)

Heart:—The autonomic innervation of the heart is of primary concern in the prevention of acute circulatory arrest. The parasympathetic component is the vagus nerve which innervates the auricles but not the ventricles. The right cardiac vagus terminates in the sinoauricular node and the left cardiac vagus terminates in the auriculoventricular node with interconnections between the two nodes. The electrocardiographic changes from vagal stimulation are inhibition of the normal pacemaker with downward displacement to the auricle or auriculoventricular node. The principal electrocardiographic findings have been bradycardia and varying degrees of auriculoventricular block. Occasionally changes in the auricular complex, ventricular premature contractions or ventricular escape may occur. Excessive stimulation may finally result in cardiac asystole.

The sympathetic cardiac accelerator nerves innervate both the auricles and ventricles. The main electrocardiographic changes from sympathetic stimulation are sinus tachycardia, ventricular extrasystoles, bigeminal or trigeminal ventricular contractions, multifocal ventricular premature contractions, ventricular tachycardia finally progressing to ventricular fibrillation.

In addition to medullary paralysis from anesthetic overdosage, the principal cause of primary acute circulatory arrest is the result of surgical stimulation of the autonomic nervous system associated with hypoxia and/or hypercarbia. Hypoxia increases the endogenous secretion of

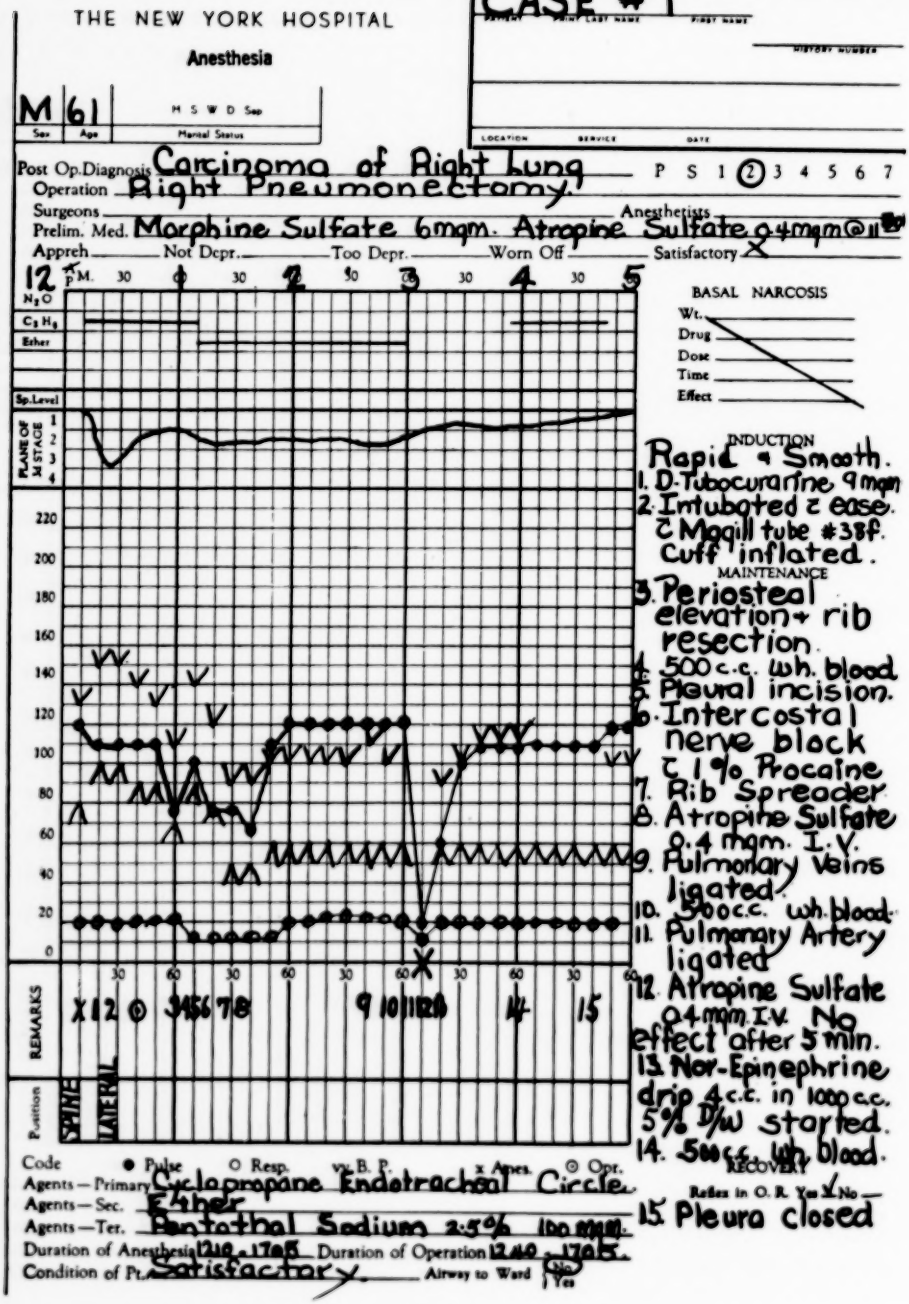

THE NEW YORK HOSPITAL
Anesthesia
CASE # 1
M 61
Post Op. Diagnosis Carcinoma of Right Lung
Operation Right Pneumonectomy.
Surgeons
Anesthetists
Prelim. Med. Morphine Sulfate 6mgm. Atropine Sulfate 0.4mgm@11
Appreh. Not Depr. Too Depr. Worn Off Satisfactory X
P S 1 2 3 4 5 6 7
BASAL NARCOSIS
Wt.
Drug
Dose
Time
Effect
INDUCTION
Rapid & Smooth.
1. D-Tubocurarine 9mgm
2. Intubated ε ease.
ε Magill tube #38f.
Cuff inflated.
MAINTENANCE
3. Periosteal elevation + rib resection.
4. 500 c.c. wh. blood
5. Pleural incision.
6. Intercostal nerve block ε 1% Procaine
7. Rib Spreader
8. Atropine Sulfate 0.4 mgm. I.V.
9. Pulmonary Veins ligated.
10. 500 c.c. wh. blood.
11. Pulmonary Artery ligated
12. Atropine Sulfate 0.4 mgm. I.V. No effect after 5 min.
13. Nor-Epinephrine drip 4 c.c. in 1000 c.c. 5% D/W started.
14. 500 c.c. wh. blood.
RECOVERY
Reflex in O. R. Yes X No
15. Pleura closed
N2O
C3H6
Ether
Sp. Level
PLANE OF M STAGE
REMARKS
Position
SPINE
LATERAL
Code ● Pulse O Resp. vs B. P. x Apex ⊙ Opr.
Agents — Primary Cyclopropane Endotracheal Circle
Agents — Sec. Ether
Agents — Ter. Pentothal Sodium 2.5% 100 mgm.
Duration of Anesthesia 1210 - 1705 Duration of Operation 1240 - 1705
Condition of Pt. Satisfactory. Airway to Ward No Yes

Figure 4

THE NEW YORK HOSPITAL

Anesthesia

CASE # 2

PATIENT — FAMILY LAST NAME — FIRST NAME — HISTORY NUMBER

LOCATION — SERVICE — DATE

F | 45 | M S W D Sep

Sex | Age | Marital Status

Post Op. Diagnosis Carcinoma of Right Lower Lobe

Operation Right Pneumonectomy.

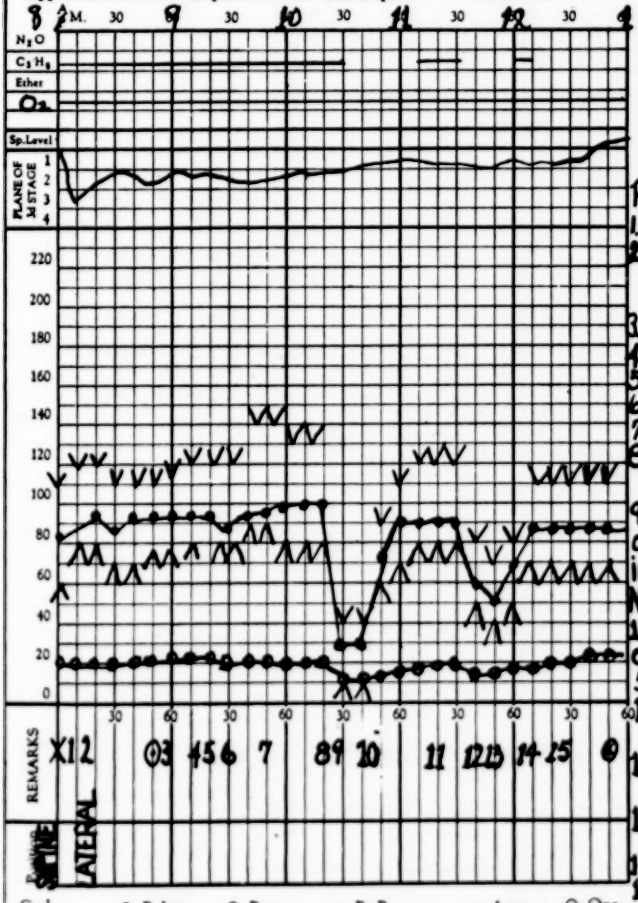
P S 1 (2) 3 4 5 6 7

Surgeons

Anesthetists

Prelim. Med. Demeral 100 mgm. Atropine Sulfate 0.6mgm @ 7a.m.

Appreh. ____ Not Depr. ____ Too Depr. ____ Worn Off ____ Satisfactory X



BASAL NARCOSIS

Wt.

Drug

Dose

Time

Effect

INDUCTION

Rapid + Smooth.

1. D-Tubocurarine 9mgm
2. Intubated ε ease ε Magill tube #35 f cuff inflated.

MAINTENANCE

3. 500 c.c. wh. blood
4. Rib Resection.
5. Pleural incision
6. Rib Spreader.
7. D-Tubocurarine 6mgm
8. Pulmonary Artery ligated.
9. Atropine Sulfate 0.4 mgm I.V. + Procaine infiltration of Hilum No effect after 8 min
10. Nor-Epinephrine drip. 4cc in 1000 c.c. 5% D/w started.
11. Pulmonary Veins ligated.
12. Bronchus clamped + Hilar traction.
13. Atropine Sulfate 0.2 mgm I.V.
14. 500 c.c. wh. blood
15. Pleura closed

RECOVERY

Reflex in O. R. Yes ✓ No —

Code ● Pulse ○ Resp. w B. P. x Anes. ⊙ Opr.

Agents — Primary Cyclopropane - Endotracheal - Circle

Agents — Sec. Pentothal Sodium 2.5% 250 mgm.

Agents — Ter. D-Tubocurarine 15 mgm

Duration of Anesthesia 0809 - 1210 Duration of Operation 0859 - 1250

Condition of Pt. Satisfactory. Airway to Ward (S) Yes

Figure 5

THE NEW YORK HOSPITAL

Anesthesia

CASE # 3

M | 14 | M S W D Sep

Sex | Age | Marital Status

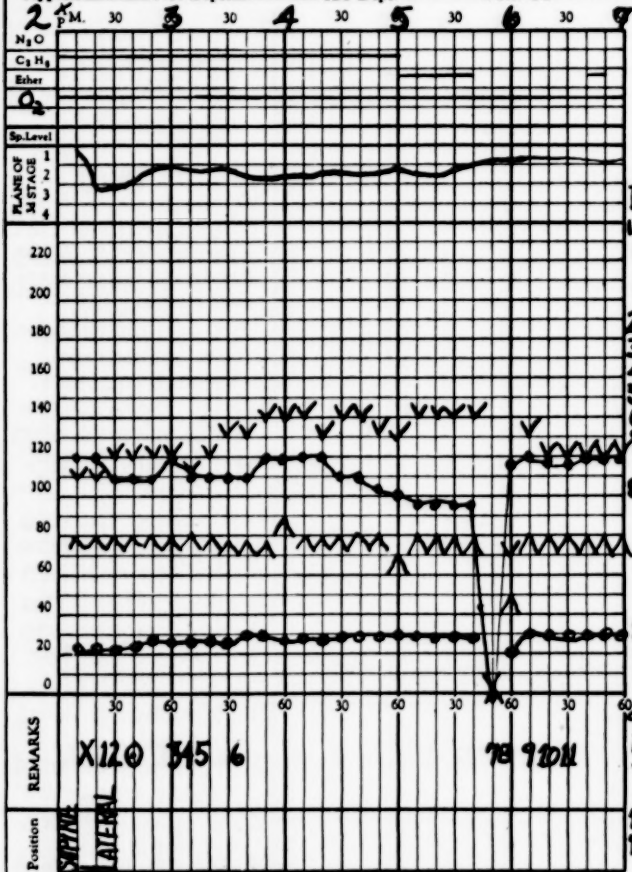
Post Op. Diagnosis Benign Tumor Right Lung P S 1 2 (3) 4 5 6 7

Operation Right Middle & Lower Lobectomy

Surgeons _____ Anesthetists _____

Prelim. Med. Demerol 75 mgm. Atropine Sulfate 0.2 mgm @ 1:45 P.M.

Appreh. _____ Not Depr. _____ Too Depr. _____ Worn Off _____ Satisfactory X



BASAL NARCOSIS

Wt. _____

Drug _____

Dose _____

Time _____

Effect _____

INDUCTION

Rapid & Smooth

1. Intubated & ease & Magill tube #30 f cuff inflated.

MAINTENANCE

2. 500 c.c. 5% D/W.
3. Rib resection.
4. Pleural incision.
5. Rib Spreader.
6. 500 c.c. wh. blood
7. Hilar Traction & Dissection
8. Atropine Sulfate 0.4 mgm. I.V.

Cardiac Arrest 5:55

Cardiac Massage 5:57

Epinephrine ¼ cc. 1:1000 in Rt. Auricle

Spontaneous irregular rhythm. 5cc 1% Procaine in Right Ventricle

N.S.R. established.

9. Hilar Region infiltrated & Procaine + 5cc. Xylocaine 2% applied topically
10. 500 c.c. wh. blood.
11. Pleura closed.

Code ● Pulse O Resp. vv B. P. x Anes. ⊙ Opr.

Agents — Primary Cyclopropane - Ether - Endotracheal - Circle

Agents — Sec. Pentothal Sodium 2.5% 200 mgm

Agents — Ter. _____

Duration of Anesthesia 1445 - 1850 Duration of Operation 1440 - 1900

Condition of Pt. Satisfactory Airway to Ward (No) Yes

RECOVERY

Reflex in O. R. Yes — No —

Figure 6

THE NEW YORK HOSPITAL

Anesthesia

CASE # 4

M | 16mos. | H S W D Sep

Sex | Age | Marital Status

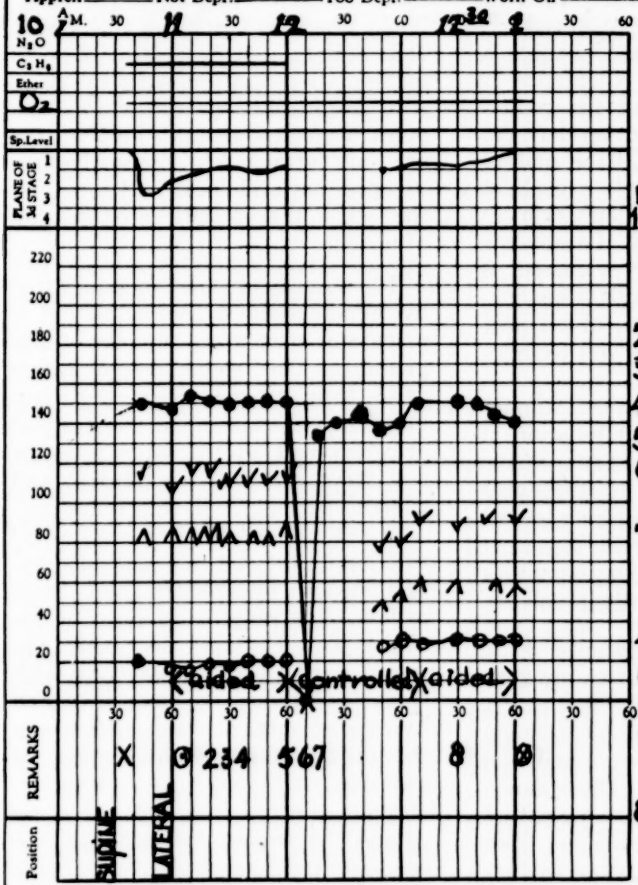
Post Op. Diagnosis Esophageal Stricture

Operation Left Exploratory Thoracotomy - Cardiac Massage.

Surgeons _____ Anesthetists _____

Prelim. Med. Morphine Sulfate 0.5mgm. Atropine Sulfate 0.15mgm @ 8:30

Appreh _____ Not Depr. _____ Too Depr. _____ Worn Off _____ Satisfactory X


10
M. 30 11 30 12 30 60 12:32 2 30 60
N2O
C2H2
Ether
O2
Sp. Level
PLANE OF 3d STAGE 1 2 3 4
220 200 180 160 140 120 100 80 60 40 20 0
REMARKS
X 1 2 3 4 5 6 7 8 9
Position
SUPINE
LATERAL
Code ● Pulse O Resp. vv B. P. x Anes. ⊙ Opr.
Agents — Primary Cyclopropane - Endotracheal - Tor Fro.
Agents — Sec. _____
Agents — Ter. _____
Duration of Anesthesia 1035 - 1205 Duration of Operation 1104 - 1200.
Condition of Pt. Satisfactory Airway to Ward No Yes

BASAL NARCOSIS

Wt. _____

Drug _____

Dose _____

Time _____

Effect _____

INDUCTION

Rapid - Crying

1. Intubated & east. & Magill Tube # 22 f & Cuff. Cut down running

MAINTENANCE

2 Rib Resection.

3. Pleural incision.

4. Rib Spreader.

5. 60 c.c. wh. blood.

6. Esophageal traction.

7. Cardiac Arrest 11:44 p.m. Resuscitated by 12:07 Procaine 1% 40 mgm in Pericardium 60 mgm Intracardiac Epinephrine 1:1000 - ¼ cc. Return spontaneous beat & N.S.R.

8 Pleura closed.

RECOVERY

Reflex in O. R. Yes ✓ No —

Reacted.

Figure 7

epinephrine and vagal tone is enhanced by both hypoxia and hypercarbia. Thus, cardiac arrest is essentially the result of excessive vagal stimulation, while ventricular fibrillation is the result of excessive sympathetic stimulation, both being enhanced by concomittant hypoxia and hypercarbia. Individual autonomic imbalance, preanesthetic drugs and anesthetic agents also exert their influence. Therefore, the prevention of acute circulatory arrest should be directed towards the avoidance of excessive stimulation of the components of the autonomic nervous system by the surgeon and the maintenance of adequate tissue oxygenation and carbon dioxide elimination by the anesthetist. Individual autonomic imbalance should be evaluated in order that proper consideration may be given in the selection of premedicants, anesthetic agents and technics.

Abdomen:—Mechanical stimulation from surgical manipulation in the abdominal cavity may provoke severe cardiovascular disturbances. The celiac plexus reflex which is sympathetic in nature and the vagovagal reflex which is parasympathetic in nature are predominantly involved.

The celiac plexus is situated in the epigastrium just anterior to the aorta at the origin of the celiac artery. Each celiac ganglion receives terminal fibers from the vagus nerve and from the splanchnic nerves. The splanchnic nerves which form the sympathetic component are postganglionic fibers arising from the lower seven thoracic sympathetic ganglion. The sympathetic reaction predominates following stimulation. The celiac plexus reflex may be observed during the course of upper abdominal surgery. Inadvertent compression of the celiac plexus from packs or retractors provokes a reflex reduction in pulse pressure without significant change in pulse rate. The reflex is enhanced by atropine and is more frequently observed during ether anesthesia. Sympathotonic patients and those with previous bilateral vagotomy are particularly prone to reflex stimulation. Spinal anesthesia to a level to produce sympathetic blockade of the lower seven thoracic sympathetic preganglionic fibers will prevent this reflex. It is best treated by ceasing surgical manipulation and removing the pressure from packs or retractors. The pharmacological therapy involves the use of intravenous physostigmine, vasopressors and local infiltration of the celiac plexus with procaine. (Fig. 8)

The vagovagal reflex is manifested by hypotension, bradycardia and a moderate narrowing of the pulse pressure. The vagus nerve which arises from the medulla in the brain innervates the abdominal viscera and proximal half of the large intestine and serves as both the afferent and efferent pathways of this reflex arc. This reflex is commonly provoked by traction on the stomach, gall bladder, peritoneum, mesenteries and renal pedicle. The reflex is blocked by atropine and is more frequently observed during cyclopropane and high spinal anesthesia. It is best treated by ceasing surgical manipulation and the intravenous administration of atropine.

During pelvic, vaginal or rectal surgery, the pelvic nerve which represents the sacral outflow of the parasympathetic division may be stimulated. The pelvic nerve innervates the pelvic viscera, descending colon and rectum. The pelvic nerve serves as the afferent arc and the cardiac vagus as the efferent arc of this reflex. It is more frequently ob-

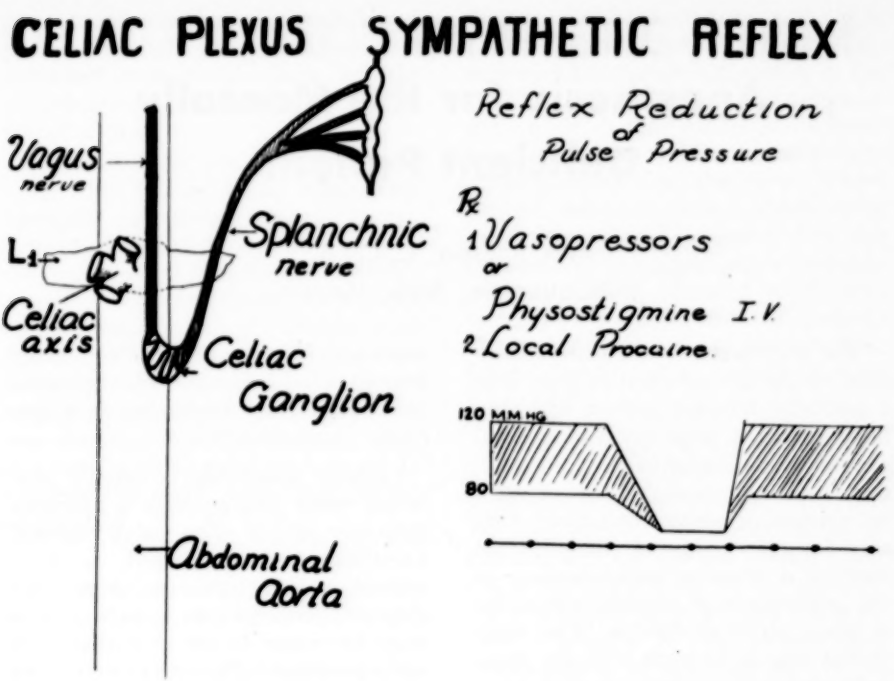


Figure 8

served during cyclopropane anesthesia and nitrous oxide and ethylene anesthesia supplemented with thiobarbiturates. It is prevented by spinal anesthesia and its occurrence is less frequent during ether anesthesia. The proper therapy is the ceasing of surgical stimulation and the intravenous administration of atropine.

Conclusion

Emphasis has been placed on the role of the autonomic nervous system in the production of cardiovascular disturbances during anesthesia. A knowledge of the anatomy of the autonomic nervous system and the physiological mechanisms involved is imperative in order to administer effective pharmacological therapy. The evaluation of individual autonomic imbalance and the selection of premedicants and anesthetic agents according to their autonomic action is an important prophylactic measure. The final result of mechanical stimulation of the autonomic nervous system is acute circulatory arrest. This can be prevented by the avoidance of excessive manipulation by the surgeon and the maintenance of adequate alveolar ventilation by the anesthetist.

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Anesthesia for the Mentally Deficient Patient

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The anesthetist in the general hospital rarely has occasion to cope with a mentally deficient patient who may have physical stigmata and general physiological inadequacy. Currently, there are few anesthetists engaged by private or state institutions that care for this group of patients, but there is a growing understanding of the importance of surgical correction of their physical defects. The anesthetist who is to work with the mentally deficient patient must have a thorough knowledge of the special problems involved, some of which may complicate the administration of anesthesia.

Perusal of the literature revealed that little has been reported on the subject of anesthesia for the mentally defective patient. Therefore, the following observations may be of interest to those who will occasionally be required to administer anesthesia to a mentally defective patient, and may stimulate other reports of experiences in this field.

General Considerations

In the majority of mentally defective children there has been imperfect embryonic development with the result that body organs and systems may have defects of structure and function. These defects are often termed the "stigmata of degeneracy."[1] Emotional instability is a frequent characteristic.

General anesthesia is usually preferred when dealing with a mentally defective patient. The use of regional anesthesia is not advised, as it is seldom satisfactory for even the slightest procedure in a patient who may be prone to be disturbed and uncooperative.[2] The inexperienced anesthetist may be lead into a sense of false security by a seemingly placid individual, only to be dismayed by an outburst of violence immediately before induction. The result will inevitably be a difficult induction and complications during maintenance of anesthesia.

280 mentally defective patients, whose ages were from 1 to 68 years, form the basis for this report. The intelligence quotients ranged from 2 to 70. The mental deficiencies were of almost every diagnostic classification. However, the following types presented the most significant abnormalities: Birth Injury, Idiopathic Epilepsy, Hydrocephalus, Microcephalus, Oxycephalus, Mongolism, Cretinism, Simple Familial Retardation, Postencephalitic Idiopathy, Spina Bifida and Meningocele. Ten per cent, or 28 patients, were complete invalids while 40 per cent, or 112 patients, were semi-invalids. The remaining 50

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per cent were ambulatory, capable of performing light, menial labor, and consisted mostly of those in the classification of simple familial retardation.

Preparation for Anesthesia

At the Dixon State School for mentally defective persons, Dixon, Illinois, basal narcosis with an intravenous or rectal barbiturate, or rectal avertin, was used and maintained until inhalation anesthesia was commenced. Inhalation anesthesia was used for maintenance. In some instances when only moderate sedation was required preoperatively, a short acting barbiturate was used in conjunction with the usual premedication.

Anesthesia

All technics of general anesthesia were used and the anesthetic agents and adjuncts now in popular use were utilized in varying combinations. The most often used combination was basal narcosis with rectal nembutal or induction with pentothal sodium, 2.5% with nitrous oxide-cyclopropane mixtures, with muscle relaxants when indicated. The surgical procedures were of a wide range involving extracranial, ocular, oral, extrathoracic, intra-abdominal, orthopedic, pelvic, perineal and rectal. Very few cases were of an emergency nature.

Special Problems

Pre-existing Anomalies of the Head: — The hydrocephalic, microcephalic and oxycephalic patients display abnormalities in size and contour of the cranial vault. The significant feature is alteration of the intracranial pressure. Agents or technics imposing a rise in an already increased pressure may cause compression of the medulla against the base of the skull and a disturbance in function of the vital centers may ensue. This may then be followed by disturbances in circulation and respiration. The two most significant factors which cause an increase in intracranial pressure during anesthesia are carbon dioxide excess and hypoxia. The former exerts a more pronounced effect than the latter. "Most central nervous system depressants raise intracranial pressure, but the influence of the agent per se is negligible, ... Most changes result secondarily from alteration of gaseous composition of the blood resulting from inadequate ventilation." (Adriani[2]).

In oxycephaly, the orbital openings in the skull are very shallow. This condition is responsible for the marked protuberance of the eyeballs; so marked that the eyelids cannot cover the entire surface of the eyeball. Extra precaution must be taken to prevent irritation of the cornea, and inflammation of the conjunctiva. If there is a disturbance of intracranial pressure and circulation, the pupils may be dilated and react sluggishly.

Severely mentally defective persons have a high incidence of ocular disturbances, e.g., congenital blindness, strabismus, nystagmus and epicanthus[3], as well as other abnormalities about the head. The respiratory passages are frequently diminished in size, with deviated nasal septa, and high palates that are either V-shaped or vaulted. Cleft palates and cleft lips are uncommon. Mouth breathing is frequent, with drying and hardening of the mucous membranes. The microcephalic patient's jaws are ankylosed, and the small angle of the open mouth often makes the maintenance of a patient's airway difficult and orotracheal intubation becomes impossible.

Oral inspection is essential before induction of anesthesia. This is not

always possible in the agitated and uncooperative patient. It is common to find decayed and loose teeth, clumps of tenacious mucus, and a wide variety of foreign bodies; for the severely defective patient will put anything into his mouth and hold it there, or will attempt to eat it. If it is not possible to examine the mouth before induction, this should be done immediately after consciousness is lost.

Pre-existing conditions affecting the respiratory system:— In the semi- or completely invalided patient the respiratory excursions and the subsequent tidal volume are decreased. This is usually due to lack of development of the chest in infancy and early childhood. The chest cage eventually becomes somewhat fixed and immobile in direct relation to the depth of the usual respiratory effort. Under anesthesia then, the respirations are often misleading unless their character has been studied prior to induction. Respiratory acidosis must be avoided by intermittently assisting the respirations.

The Mongoloid patient is unusually susceptible to upper respiratory infections, and, in addition, may have chronic and profuse nasal mucus discharges. However, he does not tolerate the belladonna alkaloids. If given at all, atropine or scopolamine should be given in small doses to avoid toxic effects at the cost of losing the drying effects.

In many mentally defective persons the mucous membranes of the upper respiratory tract are thickened. This is noticeable upon laryngoscopy and the fibrous-like appearance of the tissues above the larynx often make it difficult to identify those structures, thereby impeding rapid and smooth orotracheal intubation. It is thought that this thickening of mucous membranes is due to a low metabolic rate, as is the increased amount of lymphoid tissue that is apparent.[3]

Pre-existing anomalies of the cardiovascular system:—According to Benda[4], "Up to seventy percent of the Mongoloids show cardiac anomalies, usually being defects of the septum." The oxygen content in systemic circulation is then decreased, and such findings as clubbed fingers or mottled and cold skin, reveal the general status of tissue sub-oxygenation. In addition, significant arteriosclerotic changes occur early in the life of the Mongoloid patient.

The patient who has been confined to bed most of his life, such as those who have birth injury, hydrocephalus and spina bifida, have a diminished circulating volume of blood with resultant low blood pressure and subefficient heart action. The operative risk is increased proportionately to the amount of the lowering of the arterial pressure and the severity of the debility involved.[3] The ability to compensate for the stress imposed by the surgical procedure and anesthesia is diminished. Circulatory collapse may result from surprisingly minor causes.

These factors make it essential to provide the anesthetized patient with high oxygen concentrations and a course of anesthesia that provides the least aberrations from the normal functioning of the respiratory and circulatory systems.

Problems of nutrition and metabolism:—In spite of wholesome food being provided, the severely mentally defective patient frequently remains stunted and ill-nourished. This is thought to be due to poor feeding habits and defective assimilation, as well as to grossly unhealthful habits.[1] Nutritional anemia is preva-

lent with the majority of these patients showing hemoglobin readings three to four grams per cent below normal. Values of eight to ten grams per cent place the patient into the category of a severe operative risk. In addition to transfusions to correct the anemia, the form of anesthesia should be carefully chosen with a view of avoiding further interference with the transportation of oxygen.

In the case of chronic malnutrition found in those who cannot or will not eat properly, there is a parallel operative risk involved. There is diminution of glycogen, vitamins, and serum proteins with resultant partial starvation of the body tissues. The degree to which this has increased the surgical risk may be estimated by the amount of depression of the total serum proteins.[5] Prophylactic or therapeutic use of intravenous amino acids, vitamins, and glucose infusions serve to improve the status of nutrition and hydration.

The patient who is cachectic appears to be non-resistant to central nervous system depressants, and requires much smaller doses of these drugs than does a healthy patient of comparable age. Non-volatile drugs should be used with caution, because the rate of detoxification may be slow. The patient who is weak and emaciated is particularly sensitive to Succinylcholine chloride, probably due to abnormally low levels of serum cholinesterase. The Mongoloid patient is extremely sensitive to anesthetic agents, and the lightest anesthesia possible should be maintained in an attempt to avoid overdosage with its concomitant circulatory and respiratory depression.

Frequently, the metabolic rate is reduced, as is the metabolic reserve, without there being a well defined endocrine dysfunction. These patients have widespread physiological inadequacies. Circulation is poor, mild alteration in cardiac function is frequent, the temperature regulating mechanism is imperfect, ability to resist infections is poor, and healing powers are low. Furuncles and carbuncles, dysentery, respiratory infection and pulmonary tuberculosis occur more frequently than they do in the normal individual.

At times a mentally defective patient is resistant to anesthetic agents. This is often seen in epileptic patients who have a high tolerance to sedative drugs, and in the hyperactive and agitated defective who has little or no contact with his environment. Occasionally, massive doses of intravenous barbiturates are needed for induction alone, and then it is not unusual to see excitement symptoms such as are not often encountered with this type of induction.

Pre-existing conditions involving the muscular and osseous systems: — The birth injured patient has hypertonicity, rigidity or spasticity. Conditions with these characteristics offer the problems of a high incidence of spasms of the laryngeal and pharyngeal muscles. Carbon dioxide excess tends to increase muscle tone and must be avoided. In procedures that require moderate to deep relaxation, muscle relaxants are needed to supplement the anesthetic agents being used. Limitation of motion of the extremities due to ankylosis or tendon contractures may cause difficulty in positioning the patient. If the parts involved do not relax sufficiently after anesthesia is induced, they should be supported with pads and pillows.

In diseases of the spinal cord, e.g., post-inflammatory lesions, or anomalies, such as spina bifida, there is hypotonia, asthenia or atony. These

offer no particular problem to the anesthetist. Spinal anesthesia is contraindicated.[2] If the site of surgery is below the spinal segments affected, anesthesia is not necessary since both the motor and the sensory spinal nerves are usually involved.

Tredgold[1] says, "Common defects of the osseous system are talipes, polydactylism, syndactylism, and various deformities of fingers and toes." These frequently require surgical correction if the patient is to have reasonable function of his extremities.

Pain perception:—Although pain is experienced by the mentally defective patient, it is doubtful whether they have the same perception as has the normal individual. This inferiority of perception appears to be proportionate to the degree of defect. In the cooperative moderately and severely mentally defective patient, an uncomplicated dental extraction or minor surgical operations will sometimes be endured without anesthesia, and with relatively little concern. It is surprising, and at times disconcerting, to find how seriously ill they may be without making any complaint or showing any signs of suffering. To illustrate this want of sensory perception, it was observed that a severely mentally defective patient was up and about, asking for food, immediately before an exploratory laparotomy was performed to substantiate the diagnosis of a perforated viscus. The pathology found was a ruptured spleen with the peritoneal cavity filled with blood. The cause of the perforation was determined to be a fractured left 7th rib which was estimated to have occurred one week prior to the discovery of the injury.

Conclusion

In considering many of the aberrations of the anatomical and physiological aspects of the mentally defective patient, is is apparent that there are widespread physiological inadequacies which will make the anesthetist's work unusually hazardous. It is also apparent that the anatomical deviations provide a large field for surgical correction. These considerations make it imperative that the anesthetist be acquainted with the problems of the mentally defective patient and the enormity of his clinical deviations.

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The Future of the Nurse Anesthetist

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In 1948 there were 52 schools of Nurse Anesthesia and at the present time there are 107 schools of anesthesia for nurses with approximately 700 nurses in training. In addition, the American Association of Nurse Anesthetists expects to add an additional school, when their survey is completed.

In 1948 there were 3,200 members of the American Association of Nurse Anesthetists and as of January 9, 1956 there were 8,100 members and the number is increasing at the rate of 600 per year.

At the present time there are 1,006 residencies approved by the American Medical Association and the American Board of Anesthesiology in 188 institutions with 746 of these appointments filled.

The American Society of Anesthesiologists shows that in 1948 they had 2,680 members as compared to the American Association of Nurse Anesthetists which had 3,200 members and in 1955 the American Society of Anesthesiologists had 4,885 as compared to the American Association of Nurse Anesthetists membership of 8,100. There have been 1,408 American Board Diplomats certified of whom 32 are deceased. There are 1,000 physicians in various states or degrees of certification.

The following information taken from the work of Henry K. Beecher, M.D. and Donald P. Todd, M.D., in *Annals of Surgery,* shows the place of the nurse anesthetist in the university type hospital. The nurse anesthetist administered 21 per cent of anesthesias, the residents in anesthesia 48 per cent, the surgeons 20 per cent and the specialists in anesthesia 11 per cent.

Dr. Beecher points out that it will come as a surprise to some that in 10 university hospitals with well developed departments of anesthesia one-fifth of all anesthesia is administered by nurses and the nurses account for twice as many anesthesias as physician specialists in anesthesia.

Dr. Beecher even points out that in most hospitals the physician specialist in anesthesia carries a greater case load of poor risks but that in many hospitals there is no difference in the type of cases anesthetized by nurses and physicians. He further states and I quote "there are not enough physicians to provide anesthesia in this country; whether there ever will be can only be a matter of opinion at this time."

He found that the trend of 18 per cent for nurse anesthetists (108,000 to 128,000 per year) over the 5 year

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Presented at the Alabama Association of Nurse Anesthetists Meeting, Thursday, January 26, 1956.

study increased 3½ per cent. Whereas the physician increased 34 per cent and those by anesthesia residents increased 40 per cent.[1] This is explained by the growth in the population of the country.

Another analysis shows that nurse anesthetists administered 25,600 out of 108,300 or 24 per cent in 1948 while in 1952 they administered 26,500 out of 128,230 or 21 per cent, a decrease of 3 per cent.

It should be stated again that this information is taken from a 5 year study of 10 university departments.

Last year in a survey by the American Association of Nurse Anesthetists it was found that one member of the American Society of Anesthesiologists is available in only

10% of the 0-49 bed hospitals
22% of the 50-99 bed hospitals
53% of the 100-249 bed hospitals
68% of the 250-and over bed hospitals

while one member of the American Association of Nurse Anesthetists is available in

29% of the 0-49 bed hospitals
59% of the 50-99 bed hospitals
78% of the 100-249 bed hospitals
74% of the 250-and over bed hospitals

and that there is a combination of at least one A.S.A. or one A.A.N.A. member or both in

35% of the 0-49 bed hospitals
72% of the 50-99 bed hospitals
96% of the 100-249 bed hospitals
89% of the 250-over bed hospitals

This analysis reveals that even now only a little over 50 per cent of the anesthetics are administered by individuals whose qualifications are known. The need for additional personnel is very great even at the present time.[2]

In summary, I would like to point out to you that the population of this country has grown from 75,994,575 in 1900 to an estimated 165,000,000 in 1955 and will grow to an estimated 220,794,000 in 1975.

In a recent letter from Dr. Curtis Hickcox he states that at the present there are 1,400 American Board Anesthesiologists with 1,000 others in the process of certification. He does not believe that anytime during our generation will there be more than an adequate number of anesthesiologists. In a practical fashion we must face the fact that all anesthesia cannot be given by American Board Anesthesiologists at the present time.

It takes more surgery than is being done in most of the towns of Alabama or similar states to support a physician engaged solely in the private practice of anesthesia.

Your future lies more completely in your own hands than probably any other single group. Your own performance, cooperation with the hospital administration, benefit to the patient as well as your dovetailing into the existing situation of physician anesthesia are the factors affecting the demand for your continued services.

You must develop a cooperative attitude and you must realize and plan to work wherever possible in the orbit of physician anesthesia.

It has been shown that many nurse anesthetists can perform just as adequately as physician anesthetists in many difficult cases when adequately supervised.

The nurse anesthetist who is well trained, experienced, willing, and available (and I emphasize available) is much more desirable than the poorly trained physician inexperienced in anesthesia who may or may not be available, or the well trained, experienced, highly desirable anes-

thesiologist who may not be available then or at anytime in the near future.

I would like to call your attention to the laboratory technician, E.E.G. technician, blood bank technician, physiologist, social service worker, and many other non-physician personnel employed in and around the hospital who are doing a very acceptable and creditable job.

This merely serves to emphasize that there is a place for people in treatment of illness who are not physicians. It goes without saying that the most desirable situation would be one in which everyone had the benefit of 8 to 12 years of training required of the physician. This is impossible.

However great the desirability of such extensive training this is not within the realm of practicality. Just as it might be nice for the automobile mechanic to also be an engineer, it is impossible. It would be nice for the engineer to be an experienced and an accomplished test driver, a financier as well as an accountant and so on. The accomplishments of the nurse anesthetist are many. She, with adequate training for her job and stepping stones of experience, under adequate guidance can and should become very proficient. She must realize her limitations and she must be aware of the pitfalls that beset a person who may find herself engaged in a situation requiring more experience and training than she has had.

It behooves all of us to realize that egotism is the anesthesia that relieves the pain of stupidity.

We should all strive to do each and every task with the utomost care, zeal, and enthusiasm. We should back this effort with a continuing determination to do our best in every situation. To assist us, we should strive for additional experience, continued training, refresher courses, affiliation with proper and ethical organizations.

We might take a word of advice from Micheal Angelo, "trifles make perfection, but perfection is no trifle."

You were told last year some of the small details that enhanced the nurse anesthetist and increased her worth to the surgeon and help to the patient. Do each job well and realize that yours is a role of secondary nature. We frequently must bow to the demands of the surgeon since the surgery is what the patient seeks rather than the anesthesia. This compromising should be limited to matters which will not jeopardize the patient's welfare. It has been well said by Dr. George Humphreys, Presbyterian Hospital, New York City, when asked at an American Society of Anesthesiology, Boston meeting, November, 1955, in an answer to the question of "to whom does the patient belong, the surgeon or the anesthesiologist?" Dr. Humphreys stated that at no time in his surgical career had an anesthesiologist or nurse anesthetist called him to say that they were putting a patient to sleep on Tuesday morning at 8:00 and would Dr. Humphreys stop by and operate on the patient. His facetious comment well illustrates the fact that we are all working for the patient's benefit and that if someone must be in charge it is not the individual who plays the secondary role. He states that we all should be proud of the surgeon who is able to carry out many difficult tasks of surgery which would be impossible without the assistance of a most capable anesthetist.

We are reminded of Dr. Stuart Cullen's recent writings in which the choice of anesthesia is discussed.

The first is the safety of the patient, the second is the convenience

of the surgeon, the third is the comfort or pleasantness to the patient.

These edicts may be altered in their order except that the safety of the patient always comes first.

In the past the demand has been so great and the supply so small that a very unhealthy situation existed. This has been true among nurse anesthetists as well as physician anesthetists. Now we are gradually getting enough better trained people so that the individual who delivers a poor return for value invested is rapidly finding it more difficult to secure the better positions.

No one should be abused or taken advantage of but a full and just expenditure should be made by the patient and the hospital and a just, full and complete return must be given by the nurse anesthetist or by the physician anesthetist.

Last year I emphasized the importance of preoperative visits. Once again, I call this to your attention as a must. Now again I want to urge you to see your patient postoperatively several times, assist with the intravenous fluids and check on the proper coughing and stir up routine. In this way your anesthesia is improved. For anesthesia is not over simply because you have completed the surgery.

Be advised that with the greater supply, a higher demand of quality will be required. The university hospital and the private hospitals of the large city will have available more and more medical anesthetists. This competition means you must be on your best technical guard in order to avoid having all good cases go to the physician. As the physician becomes available, your anesthesia must improve. You no longer give just any anesthesia. It must be good anesthesia.

The first rate nurse anesthetist is not going to be replaced as some physicians would have you believe. In time quite a bit of the anesthesia will be administered by physicians but at the same time tremendous growth in population and increase in number of geriatric patients will be such that the work load of anesthesia personnel will be increased. Here the nurse anesthetist can find herself busy even in the orbit of many physician anesthetists.

The individual nurse anesthetist must become more proficient in endotracheal anesthesia. One leading surgeon stopped using nurses because he lost a patient when the nurse could not intubate the patient. He is willing to use a nurse anesthetist when an anesthesiologist is available in the surgical suite. This will be the case more and more. If a surgeon has a difficult case, he may prefer a physician but will accept a nurse anesthetist if the nurse is well qualified and where a physician is readily available should some unforeseen problem arise.

Practically speaking you must learn to "sit with spinals". I hear many nurses moan over this. I do it all the time, frequently having to intubate the spinals, give vaso-pressors, oxygen, assistive ventilation and other measures of support. This all seems to me to require a skilled individual beyond the individual who administered the spinal anesthesia unless he is a physician who remains with the patient as an anesthetist throughout surgery.

You need to keep abreast of all new drugs and their relationship to anesthesia. As for example, Thorazine® or cholorapromazine in spinal or general anesthesia. You should learn about the various ventilators, hypothypothenia, and E.E.G. anesthesias. The new inhalation agents,

such as Vinamar®, trichlorethylene, double sulfur barbiturates should be learned as well as the new curare preparations.

I am very disappointed to see surgeons treat shock without calling in an anesthetist to help with fluids, blood replacement and oxygen administration. Routine cases of pulmonary edema and aspirations of trachea are frequently cases in which a physician or nurse anesthetist could be of great assistance.

Many times I have heard nurses lament over being asked to render some extra service. This day and age of grumbling is fast disappearing. Remember that at present the physician anesthetist sees the patient preoperatively and postoperatively and does assist freely and gladly with these extra curricular matters.

You too must render these trimmings willingly and freely when called upon to do so by the surgeon.

As a small part of the great and complex business of anesthesia, I feel that we are not going to be expected to continue to keep the nurse anesthetist employed who shirks her duty in any way. The nurse anesthetist must cease bickering and become a full cooperative member of the surgical team.

One who is on time, reliable, well trained, alert to the call of duty beyond the ordinary, and ever advancing her experience and training.

My great competition in the hospital where I work rests with my skilled nurses. They are good and are becoming better as we work together. All of this has made me work harder. My surgeons are pleased, the administrator is receiving return for value, the patient is getting better anesthesia and they like the nurse anesthetists. All of this is something to be proud of.

As of this date I have always had a candidate waiting to go into anesthesia at any time. This is encouraging as we need more and better nurse anesthetists.

Recently I fell out with the statement that all nurse anesthetists are going to be replaced. This is just not practical thinking, at least not now or in the near future.

However, the day and age is gone when the nurse anesthetist says she will quit if a physician anesthetist comes into the area. I hope no one feels that way now, even if you once felt that way.

Seek out a physician anesthetist of the highest caliber or a well recognized center where you may go to observe and to obtain the answers to your questions. You will be a better anesthetist for having done so.

The future of the nurse anesthetist rests with the individual. She will become better and keep her place or she will be replaced by a better trained nurse anesthetist or in many cases by physicians. However, it will be a long time before all the openings in the ranks of nurse anesthetists become more than partially filled. You must strive to be a better member of the rapidly advancing team, you must assume your responsibility as a nurse, as an anesthetist and as a person. If you do, you need have no fear for the place of the nurse anesthetist of the future.

The future professional status of the nurse anesthetist rests in her knowledge, skill, and experience which she must use to her greatest ability in serving the patient. Every nurse anesthetist has the obligation to keep this knowledge and skill re-

(Continued on page 147)

Dental Office Anesthesia

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When the position of Dental Office Anesthetist is considered, certain real and rumored hazards are recalled promptly. A few of these are: 1. Explosions are possible because of the close proximity of electric drills and anesthetic gases, 2. "Sodium Pentothal® should not be used on head cases," 3. "Dentists use 100% nitrous oxide with the concomitant cyanosis," 4. Dental surgery is conducted with the patient in the sitting position, 5. Dental Office patients are ambulatory and, 6. "Dental patients are not premedicated." This article presents one oral surgeon's methods which permit comparative safety from these hazards and their sequelae.

The preparation of the patient begins when the well-oriented and efficient receptionist asks whether the patient desires the extraction under local anesthesia or sodium pentothal®. Most patients seem to choose Sodium Pentothal®. However, even though the patient selects local anesthesia, if the proposed extraction may be difficult, the receptionist tells the patient not to eat nor to drink for five hours before the appointment time. All patients wait in an attractive, typical dental reception room. A few minutes before the surgery is to begin, the receptionist asks the patient to go down the hall to the rest room. If the patient seems puzzled, she adds that he should be sure his bladder is empty before surgery.

At the first examination, the oral surgeon questions the patient on his medical status. If he finds any problems, he calls the patient's physician and discusses with him the effects of anesthesia on the patient.

Preparation of Children

Children usually receive no premedication. The child under three years of age sits on his mother's lap in the dental chair and is given ethyl chloride on a slowly lowered ether mask. Since extraction in so young a child is usually for broken teeth, anesthesia for only part of a minute is necessary.

Children in the next age group, four to eleven years, are seated in the dental chair with the mother standing before them. These children are then oriented by the oral surgeon who places a gold colored plastic ring on the left ring finger and tells them to make a tight fist of the hand with the ring, just as soon as the gas makes them feel "funny". Induction is with 100% nitrous oxide through a nasal mask held above the nose and mouth. As the child approaches analgesia, a rubber tourniquet is placed on the left arm and the child reminded to double up his fist. Two cubic centimeters of 2½% Sodium Pentothal® are injected intravenously. It is then possible to change the gases in the breathing bag to 20% oxygen and

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80% nitrous oxide and to fasten the nasal mask in place. The mother goes into the reception room to wait. Higher percentages of oxygen can be given if deemed necessary and Trimar® added to maintain anesthesia in the first plane. The gas machine does not have a soda-lime canister because Trimar® with soda-lime forms dichloroacetylene.[1] Rebreathing is not used with children.

Children in the next higher age bracket are treated as adults except for medication dosages and orientation, which depend on their individual physical and psychological level.

Care of Adults

As soon as possible after an adult sits down in the dental chair, venipuncture is performed and a 2 cc. test dose of Sodium Pentothal® is given. The procedures which follow depend on the patient's condition and the type of surgery. There are four general categories based on planned surgery:

1. Extractions of 1 or 2 teeth lasting 1 to 5 minutes with no bleeding problems: — Sodium Pentothal® induction; Nitrous oxide, oxygen and Trimar® for maintenance.
2. Simple extractions of 3, 4 or five teeth lasting 4 to 10 minutes: — Atropine sulphate intravenously; Sodium Pentothal® for induction; Nitrous oxide, oxygen and Trimar® for maintainance.
3. Impactions with bleeding problems that can be controled by suction: — Atropine sulphate-demerol intravenously; Benadryl® intravenously, to control tissue edema; Sodium Pentothal® for induction and during anesthesia as needed; Nitrous oxide, oxygen and Trimar® for maintainance.
4. Full mouth extractions, long cases, bleeding problems that are difficult to control with suction, and surgical corrections: — Pontocaine 2% sprayed in nasal passages and pharynx after venipuncture; Demerol and atropine sulphate intravenously; Benadryl® 1 cc. intravenously, 1 cc. intramuscularly to control tissue edema; Sodium Pentothal® for induction and during anesthesia as needed; Nitrous oxide, oxygen and Trimar® for maintainance; Curare 2 cc.'s intravenously; Anectine in 1 cc. amounts, available; Naso-tracheal intubation under direct vision.

Demerol and atropine sulphate are given intravenously immediately after the test dose of sodium pentothal®. Then 1 cc. of Benadryl® is given intravenously, followed by an anesthetizing amount of Sodium Pentothal®. If it is a procedure from the fourth category, 2 cc.'s of curare are given next, the nasal tube placed in the pharynx and the vocal cords exposed with the laryngoscope. If the cords are not relaxed, 1 cc. of anectine is given intravenously and intubation completed. If respirations are not spontaneous, the exhalation valve may be closed and the breathing controlled manually with 100% oxygen or nitrous oxide and oxygen as needed until voluntary respiration returns. The exhalation valve is reopened, the bag emptied and the case continued with 80% nitrous oxide, 20% oxygen and Trimar® as needed for first plane anesthesia. Some rebreathing may be established by diminishing the volume flow of gases, otherwise the case is continued with non-rebreathing.

Care After Anesthesia

The office contains 2 recovery rooms, each equipped with a low cot and a chair. Patients awaken a few minutes after surgery is completed and are gently encouraged until they

can walk with assistance to one of the nearby recovery rooms. Here, they are permitted to rest but encouraged at frequent intervals to stand up and walk about in the room. Within 15 minutes to 2 hours, they are able to walk unassisted to the elevator. They are required to have someone accompany them home and are not permitted to drive their cars, although many feel that they are able to do so. Patients who have had a gram or more of Sodium Pentothal® and more than 25 mgm.'s of demerol, are given 1 cc. of metrazol intravenously, immediately after surgery unless they are already reacting well. Extubation is not attempted until reflexes are evident. Gentle suction accompanies extubation with a slight hesitation while the tip of the intratracheal tube is in the pharynx where some mucus and blood is usually found. Extubated patients are asked to cough occasionally while in the recovery room.

Safety of the Method

The comparative safety mentioned in the first paragraph, can be elicited from this discussion of agents and technics. The possibility of explosions by a spark from the electrical equipment in contact with anesthetic gases is eliminated by the use of only non-explosive agents. The possible fire hazard from high oxygen and nitrous oxide content in room air is minimized by freely ventilating the surgery during and between cases. The problems inherent in the use of Sodium Pentothal® on head cases are avoided because the patient is not surgically draped and the equipment for intubation is always ready. Sodium Pentothal® obviates the use of 100% nitrous oxide on all but the 4 to 11 age group, who receive some room air with the nitrous oxide and are not permitted to show signs of anoxia. Although anesthetizing the patient in a sitting position is frequently accompanied by a drop in blood pressure, it rapidly returns to normal because of the light plane of anesthesia required for oral surgery. A bite block is used to keep the mouth open, therefore, upper first plane anesthesia is adequate for most cases. The average anesthetizing amount of Sodium Pentothal® 2½% is 8 to 10 cc.'s for women and 10 to 15 cc.'s for men. The dental chair may be altered to allow the supine position or even Trendelenburg position if shock is evident. Ambulation immediately after surgery raises this same problem when the patient first stands up. Patients must be able to sit up by themselves without support before they are asked to stand up. When necessary, patients are carried to the recovery room, usually only to expedite the surgery schedule.

Although the premedication, demerol and atropine sulphate, facilitate general anesthesia, it is given too late to allay psychic trauma. The unapprensive patient for dental surgery is rare. Nevertheless, by the judicious use of ethyl chloride and Trimar®, only occasional cardiac arrhythmias occur. These respond to the prompt use of 100% oxygen.

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The Effects of General Anesthesia Upon Circulation

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The effects of general anesthesia upon circulation have often been ignored or minimized. Nevertheless, investigation of the circulation during anesthesia has shown that as soon as anesthesia is induced, major circulatory adjustments begin. Almost half of the cardiac output becomes distributed to the skin and muscles of the body. This is evidenced by the flushed, warm skin and the increased size of the veins developing soon after induction. It can be concluded that this is a compensatory vasoconstriction in the splanchnic vascular bed with redistribution of blood to the skin and musculature. This redistribution of blood flow usually occurs in presence of fall in blood pressure. When anesthesia is prolonged, the increased skin and muscle blood flow declines, the increased skin and muscle blood flow declines and approximates the preanesthetic level. Cardiac output falls appreciably in the majority of patients, but rises in a small minority of them. Peripheral vasoconstriction occurs in the majority of patients in the late phases of prolonged surgery. There are a few who display vasodilatation after prolonged surgery. Investigation of the blood flow in sympathectomized limbs in anesthetized individuals showed that this redistribution of blood occurs by either of two methods. Patients coming to surgery, who had previously had a sympathectomy were investigated for the effects of anesthesia on the blood flow in the sympathectomized extremities. Cyclopropane produced vasodilatation in the sympathectomized limbs, but to a lesser extent than when the sympathetic nerves were intact. From these findings, it was concluded that cyclopropane produces peripheral dilatation by a direct action on the vasomotor center and a local action on the vessel. Ether was likewise investigated and was found to produce no effect on sympathectomized limbs, but did cause vasodilatation with intact sympathetic nerves. It was concluded that the vasodilating action of ether acts on the vasomotor center with a negligible local effect.

Bennett, Brosett and Beecher[2] investigated the influence of anesthesia on the circulation in order to obtain the best agent for seriously wounded patients. Dogs were used in normal and shock states. With sodium evipal anesthesia, deepening of the anesthesia in subjects in good condition was followed by a reduction in blood pressure. Both systolic and diastolic pressures were affected, together with a

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rise in venous pressure and diminution of flow through the femoral, carotid and mesenteric vessels. Maximum effect occurred one minute after injection, followed by gradual return to original levels. With animals in shock, similar changes occurred but return from low levels was retarded and the preanesthetic levels were not attained. The dogs in good condition given ether anesthetic showed a rise in venous pressure and a slight rise initially in blood pressure, followed by a fall. There was a diminution of blood flow through the femoral, carotid, and mesenteric vascular beds. These conditions rapidly returned to normal upon discontinuance of ether. Similar results were produced with shock states but the return to preanesthetic levels was slower. Deepening of the anesthetic repeatedly was quite deleterious and hastened shock. As shock progressed under ether anesthesia, systolic blood pressure fell with narrowing of the pulse pressure. With cyclopropane anesthesia, venous pressure rose and pulse rate decreased. Flow through the femoral vascular bed was decreased but that of the carotid and mesenteric vascular beds increased. There were no deleterious effects noted with repeated deepening of anesthesia. Similar results were noted in dogs with early shock. As shock progressed, systolic and diastolic pressures fell at the same rate with pulse pressure remaining about the same. These results indicate that cyclopropane might offer a wider margin of safety for anesthesia in shock than ether or evipal.

Virtue[16] studied the survival time in shocked rats and came to similar conclusions. Irreversible traumatic shock was produced and the rats were then anesthetized with ether, cyclopropane or pentothal. Survival time was longer in rats receiving pentothal and cyclopropane than in rats receiving ether anesthesia.

Zweifach[17] studied peripheral circulation in dogs subjected to standardized bleeding procedure during anesthesia. Blood loss was tolerated best with local or cyclopropane anesthesia. With equivalent blood loss, blood pressure varied with each anesthetic agent and was the least reliable index of the animal's condition. Blood flow reflected most accurately the animal's general condition. This was studied by direct examination of the blood vessels in the mesentery. The most efficient flow was with local and cyclopropane anesthesia. Vasomotor activity was depressed by pentothal and ether anesthesia, but not by procaine local or cyclopropane anesthesia. These investigators utilized these methods with normal dogs and by varying the depth of anesthesia found an interference with the functional efficiency of peripheral circulation. The degree of efficiency impairment varied with the different agents as well as with depth of anesthesia. In all instances, anesthetic drugs, when used to induce surgical anesthesia, served to decrease the effectiveness of the individual vascular compensatory mechanisms. Ether produced the most interference, cyclopropane the least and pentothal was intermediate in its effect.

Investigation of the heart contractile force and cardiac output in dogs has shown that ether, cyclopropane and vinethene reduce this phase of the circulatory dynamics by 15% in plane I and 37% in plane 4 of Stage III. Chloroform produces a much more marked effect with a 42% drop in force in plane 1 and a 72% drop in plane 4. Blood pressure parallels this effect with chloroform producing

a marked drop at corresponding levels. The blood pressure is only slightly decreased with light ether and moderately depressed in deep planes. Cyclopropane produces a slight elevation initially with subsequent decrease.

Cardiac output usually goes down after the onset of anesthesia, but this is not necessarily true in all patients. In eleven patients given ether anesthesia and studied by Fletcher and Pender[8], the cardiac index in four increased 60% above the mean preanesthetic levels during the first hour and remained at 33% above this level during the second hour. In the other seven patients, the cardiac index dropped to 23% below mean preanesthetic levels during the first hour, 29% the second hour and was 25% below the third hour. The rise in cardiac index was related to a marked excitement phase. The blood pressure fell and was related to the cardiac output and not to the peripheral vascular resistance. Venous pressure was elevated throughout the anesthesia. A decrease in arterial pH was associated with an even greater elevation in central venous pressure.

Formerly, ether was regarded as a stimulant to the heart. Brewster[4] has shown that ether is a direct depressant of the myocardium. By careful investigation he found that ether anesthesia caused a release of adrenalin from the adrenals and the sympathetic nervous system. This adrenalin maintains or increases cardiac output in the face of direct myocardial depression by ether. If the sympathetic system and adrenals are not functioning, cardiac failure would occur at surgical anesthesia levels with ether. With advent of radical adrenal surgery, one must consider this characteristic of ether anesthesia.

Etsten[6] studied the effect of cyclopropane on a small group of patients. During light anesthesia, the cardiac index decreased 22%. Total peripheral vascular resistance increased 56%. There was no change in stroke volume and the pulse decreased 17%. The results indicate that the disproportionate increase in peripheral resistance is responsible for reduced cardiac output.

With thiopental anesthesia, Etsten[5] found that cardiac output did not change with simple hyponosis but was reduced 25% during surgical anesthesia. The intrathoracic blood volume decreased paralleling cardiac output. Pulse rate increased, but not enough to maintain cardiac output. The reduction in output was thought to be due to the redistribution and pooling of blood causing a diminished venous return to the heart.

Fieldman[7] investigated the combination of nitrous oxide and thiopental as it is commonly used in anesthesia. The electroencephalogram was used to determine depth of anesthesia. Cardiac index with light anesthesia decreased 24% and a decrease of 48% was noted with deep anesthesia. When anesthesia was lightened, cardiac output returned to normal levels very slowly. Blood pressures dropped 19% in both light and deep anesthesia but returned to preanesthetic levels in three to four minutes. The greatest drop was in patients who had the highest mean pressure. Peripheral resistance was unchanged with light anesthesia but decreased with deep anesthesia. Arterial blood pH decreased in proportion to the depth of anesthesia as did oxygen. These changes in oxygen and pH could be prevented with adequate ventilation of patients. The decrease in cardiac output could not be pre-

vented and presented a hazard to the cardiac patient with a low cardiac reserve.

I have been emphasizing the effect of anesthetic agents upon the circulation. This emphasis is not intended to minimize the importance of technical administration of anesthesia. One of the greatest technical hazards is inadequate ventilation with its concomitant hypoxia and hypercapnia. This state may be the result of airway obstruction or respiratory depression secondary to anesthetic drugs. The hypoxia and hypercapnia can result in remarkable changes in circulation during the anesthesia and postanesthetic periods. Circulation may be markedly altered by efforts of the anesthetist to assist or control respiration. All of these changes, when coupled with the vascular changes, directly due to drug effect, may increase morbidity and mortality rates remarkably.

SUMMARY

There is a redistribution of blood to skin and musculature soon after onset of anesthesia. Increased peripheral circulation usually approached preanesthetic levels during the course of anesthesia. This explains the venous distension and increased bleeding that is seen early in surgical anesthesia.

All anesthesia interferes with circulation with reduction in cardiac output. This varies with the depth of anesthesia and anesthetic agent. Cyclopropane probably has the least effect and is the agent of choice in a shock state.

Technical ineptitude can compound the depressant effects of any anesthetic agents, with serious outcome a likelihood.

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The Relationship between the Surgeon and the Anesthetist

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There would be little excuse for my appearance before you if the attitude of the medical profession toward nurse anesthetists presented no problem. To deny that such a problem exists would be unrealistic. My purpose is to attempt to state the problem as I see it, and to voice the position taken by the American College of Surgeons in the controversy.

Anesthetic agents, both topical and inhalation, were developed by the profession, and were first demonstrated and employed by doctors. The study of the altered physiology occasioned by their use, and the measurement of their effectiveness, as well as their indications and contraindications, have been the concern of the medical profession for many years. It has been a part of the teaching of most medical students to expose them to the disciplines of administration of anesthetics to the extent that they learn enough to realize the potential dangers, and to know something of the measures to prevent or combat improper administration. Thus, it is quite evident that the medical profession feels some pride of authorship, and a real continuing interest.

When the available inhaled agents consisted of chloroform and ether, many doctors knew all there was to know about them and administered them as effectively as their small knowledge permitted. Results were quite variable, and the anesthetist of that era was often regarded rather poorly, and accorded small dignity.

As newer agents were developed, more complicated equipment required, and with closer limits of tolerance, it became apparent that more and advanced training would be necessary if the anesthetized patient were to receive the best possible care. At this point many of the relatively untrained doctors, who gave an anesthetic agent occasionally, began to discontinue that practice. It should be noted, in passing, that this last statement is relative. There are still many communities in this country where a doctor with small additional training, but with a special interest, produces anesthesia with inhalation agents in addition to his practice in some other field of medicine.

As the need for anesthesia grew, due to asepsis and the growing capabilities of surgeons, the need for trained anesthetists also increased. The proportion of doctors in this country wishing to devote their efforts to this field has never been great, possibly because other fields seemed

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more dramatic, and a quite natural evolution was the delegation of this activity to a nurse. Originally, with the small knowledge of what was being done to the patient beyond the evident anesthesia effect, the instruction of the nurse consisted largely of the fundamental technics, and advice to continue administering the anesthetic agent until told to stop. The surgeon assumed the major responsibility because of his own greater experience. Gradually, the anesthetist learned to gauge the effects of the agent and to recognize the signs of effectiveness and of danger. Eventually, she became adept and competent in the light of the knowledge of the time. I am told that the first instruction of nurses as anesthetists was at St. John's Hospital, in Springfield.

Concurrently, investigators were developing the more modern agents, designed for special applications, but carrying inherent factors of additional danger. These required special training and stimulated the study of altered physiology during their use. Thus, graduate training in this specialty became a necessity for not only nurses, but for doctors as well.

As a result of residency programs, and post-graduate courses, a body of specially trained doctors has developed. These men are adequately trained for medical licensure and additionally qualified as anesthesiologists. They are thoroughly grounded in the application of modern knowledge of basic sciences to their specialty. Many of them are educated in the use of the bronchoscope so that it may be used in bronchial toilet after operation when necessary. They belong to special societies by which they are kept advised of developments in agents, equipment, technics, and management of patients. Most of them are better qualified to determine the agent to be used, and the conduct of anesthesia in any particular case, than is the surgeon. When available, they give the conscientious surgeon a feeling of great confidence that his patient is being cared for well. Additionally, they take legal responsibility for their own actions.

In 1934, there were about 500 medical anesthesiologists in this country. The number now is about eight times that, and the A.M.A. reported 850 in residency training in 188 programs in 1955. The first medical journal devoted to the specialty in this country was started in 1922, and the American Board of Anesthesiology was organized in 1937. There have been 1503 "career" anesthesiologists certified by that board, up to 1 July 1956.

The organization which embraces most physicians devoted to this specialty is the American Society of Anesthesiology which, through assemblies and publications, provides post-graduate education for its members. It is concerned, also, with problems of professional relations and "ethics." Possibly because of the lack of regard accorded to the anesthetist of the early day, this society has been most vocal in its demand that the anesthesiologist be accorded his "place in the sun," be recognized as a practitioner of medicine, and be expected to bill for his work on a "fee-for-service" basis, rather than to accept employment by a hospital or other institution.

When one considers the various conditions of hospital practice of surgery, it is evident that the anesthetist can not always send a "fee-for-service" bill. He certainly can not if he is working in a tax-supported institution where patients are not charged. Further, he should have

supervisory, research and teaching duties, for which the institution should expect to pay. Additionally, it is most common for the institution to supply his equipment and agents, and payment for their use is justified. Thus, to demand that all anesthesiologists bill the patient directly is manifestly impossible.

The House of Delegates of the A.M.A. has considered the problem of employment of a physician by an institution, and has declared that such employment is to be considered unethical, per se, only if the physician is exploited. Otherwise, a doctor may decide for himself whether to work for a salary, be paid on a commission basis, or receive a fee-for-service, provided his occupation is legal and ethical. Such employment of an anesthesiologist may well permit the submission of bills for services rendered to some patients, while providing an income on some other basis for other services. This argument as to concept is a "growing pain," I am sure, and illustrates the fact that this compartment of specialization is relatively young.

Now where does the nurse anesthetist fit into this era of residency training of anesthesiologists? It must be admitted that she starts with less basic scientific training than is demanded of the medical student. If her training program had not advanced in recent years, she would not be adequate. However, while educating doctors in this specialty, the teachers have also trained nurses, insuring their competence with the modern agents and technics. They form a valuable body of surgical team members, without whom much of the surgery done in this country could not be accomplished.

At this point, I should like to endorse the concept of the nurse anesthetist as a part of the surgical team. Modern surgery often demands modern anesthesia, as well as modern methods of treatment, and the person at the head of the table plays a vitally important role. If it be a nurse, she must have adequate knowledge of what the surgeon is trying to do, and what he will want to do next, in order to give the patient the best possible service. She must be a part of the team to the same extent as the surgical assistant or the instrument nurse. Her sphere of knowledge and interest cannot stop at her screen.

Where, then, is the problem of which I spoke at first? It is, I believe, that some of the educators in the specialty, and some of the most active practitioners of anesthesiology, feel that doctors only should practice this art, and that nurses should not be educated in it, nor allowed to administer anesthetic agents. What percentage of anesthesiologists believe this way, or what part of those are self-seeking and what part are honest and sincere, *I do not know. I do* know that some have been quite vociferous about it, and the abolition of training of nurse anesthetists has been advocated by at least one major special study made up of anesthesiologists.

Some of those who oppose the training of nurse anesthetists may do so from a conviction that the modern specialty is so complex that medical school education is demanded as a basis. One cannot adequately refute the argument that a physician should be able to bring something to anesthesiology which could not be expected of a nurse. My personal experience, however, is that an ade-

quately trained nurse sometimes is responsible for smoother anesthesia than a highly skilled anesthesiologist. The best anesthetic combines rapidity of induction, smoothness, effectiveness, and safety for the patient in the best possible compromise, and does not necessarily imply complexity. The human element enters into this picture, as it does into everything else.

The attitude of the American College of Surgeons toward this controversy can be stated. It is that the training of anesthesiologists should be encouraged and augmented, but that the training of nurse anesthetists should be continued. The College is not alone in this attitude. It is expressed by many of the leading educators in this special field, and is the reason for their efforts as the directors of programs in which nurses are trained.

Whether the time will ever come when the supply of anesthesiologists may meet the demand is problematical. Your society, by encouraging and demanding high standards for nurse anesthetists, is insuring their availability until that time comes. At least until then, nurse anesthetists are a special necessity, and an ever-present help.

Notes and Case Reports

Adrenal Insufficiency

Mrs. S., a 43 year old female was admitted to the hospital because of a large tumor mass in the lower left quadrant. Physical examination revealed a poorly nourished pale woman with normal heart and lungs and the large abdominal mass. Laboratory examination revealed a hemoglobin of 6 gms. and x-ray evidence of left hydronephrosis. Preoperatively, she received five blood transfusions, one every other day, raising the hemoglobin to 11 gms. The patient had not been taking any medication for at least one year before surgery.

On the day of surgery she was given morphine sulfate 1/6 grain, and scopolamine 1/150 grain for premedication. Induction was accomplished with Sodium Pentothal 250 mgm. When consciousness was lost, Quelicin drip 0.2% solution was then started intravenously and oxygen inhalations were started. A no. 36 endotracheal cuffed tube was inserted with ease. The administration of N_2O—Oxygen and Quelicin drip was used for maintenance. The initial blood pressure was 112 mm. systolic and 70 mm. diastolic, and the pulse rate was 120. During induction and intubation the blood pressure remained constant. When the patient was placed in the right lateral position and the kidney bar elevated, the blood pressure dropped 64/20. Wyamine 1 cc. was given I.V. with no appreciable effect. After 10 minutes Aramine 5 mg. was given I.V. Within a short time the pulse and blood pressure returned to within her normal limits, and the respirations were assisted.

The operation was begun and a large cystic mass about the size of a football was found. A trochar was inserted into this large mass before attempting to remove the kidney. About 1000 cc. pus was aspirated. While dissecting the kidney free, the adrenal gland was encountered in the substance of the mass, and had to be removed in the subsequent dissection. During this interval the blood pressure gradually fell and became unobtainable, the pulse increased in rate, and her color was very pale. The surgeons reported minimal blood loss. The anesthetic and Quelicin drip were discontinued, oxygen was given, and respirations were assisted. During the next hour the following solutions and medications were given I.V. with no response;

500 cc of 5% Glucose with 10 cc of Aramine,
200 cc Dextran,
500 cc Whole Blood, and
500 cc Glucose with 4 cc of Levophed

At the close of the operation the respirations were regular and deep but the blood pressure was still unobtainable. Her pulse was rapid and weak, color pale, skin cold and clammy, and the pupils were widely dilated.

The patient was extubated and responded to verbal stimuli. Before leaving the operating room, hydrocortisone 100 mg. was given I.V. About 20 minutes later in the Re-

covery Room the blood pressure was 40 mm. systolic, pulse 138 and weak, respirations 30, regular and deep. In the Recovery Room she was given Oxygen by mask and the blood pressure was maintained at 40 mm. systolic with Aramine. After two hours her condition became suddenly worse, blood pressure was again unobtainable and the pulse was imperceptible at intervals. The presumptive diagnosis was then made of acute adrenal deficiency, since no signs of excessive blood loss were noted on the dressings or from the drainage tubes.

An aqueous solution of Adrenal Cortical Extract 10 cc was given I.V. followed by 500 cc 5% Glucose in Saline with 3 cc Aramine and 5 cc of ACE. The pulse within a short time was perceptible and blood pressure was 70/40. One half hour later another 500 cc 5% Dextrose in Saline with 3 cc Aramine and 10 cc ACE was added to the previous I.V. solution. At this time the blood pressure was 130/70, pulse 150, skin warm and dry, and the patient was responding to verbal stimuli. Hematocrit and hemoglobin reports showed hemoglobin 11 gm., hematocrit 38%.

The patient was catheterized and 200 cc of urine were obtained. A Foley catheter was left in the bladder. One half hour later 1000 cc 5% Dextrose in Saline with 10 cc ACE, 5 cc Aramine, and 10 cc of Eschatin Suprarenal Extract followed the previous I.V. fluids. Intravenous fluids and ACE were continued for 48 hours, after which 25 mg. Cortisone were given by mouth four times daily. This dose was gradually reduced. Two weeks later she was receiving 25 mg. of Cortisone once a day. Urinary output totaled 1000-1500 cc per day. She has had an uneventful recovery to date.

The purpose of this case presentation is to alert anesthetists to the symptoms and management of postoperative adrenal insufficiency.

John Garde, R.N., and
Sr. M. Yvonne, Director
St. Francis School of Anesthesia
La Crosse, Wisconsin

Members of the American Association of Nurse Anesthetists have received on a number of occasions certain literature from an organization calling itself the International Association of Anesthesiologists, Inc. For the sum of $10.00 applicants will be enrolled as a "charter member" in both the International Association of Anesthesiologists and in the International Medico-Legal Society. "Beautifully engraved Certificates of Membership in both organizations will be forwarded without additional charge."

The Board of Trustees of the American Association of Nurse Anesthetists has received no information from either of these organizations which would permit any statement as to the desirability of membership in these two associations. At this time the American Association of Nurse Anesthetists does not recommend membership by nurse anesthetists.

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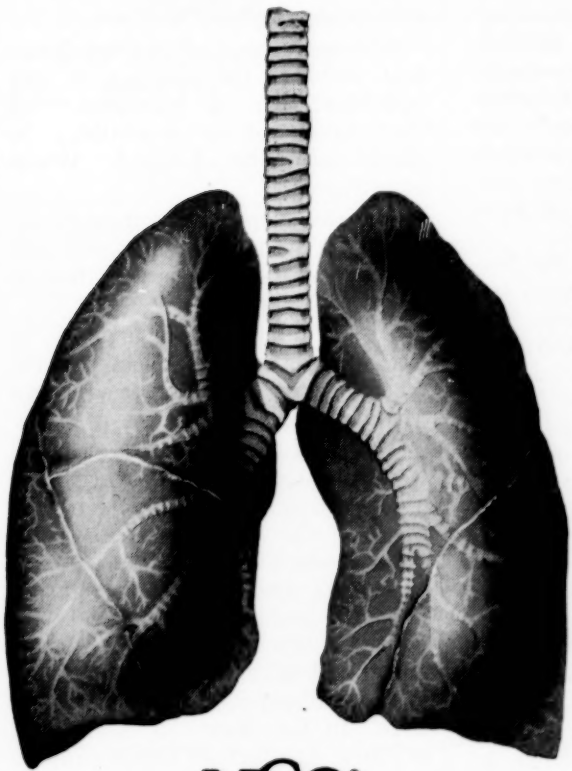

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Insurance

A MESSAGE FOR STUDENT MEMBERS

If you have not already been contacted, rest assured you will be in the very near future. Many insurance agents will have the "finest", the "best" and "the most comprehensive" type of insurance, and all at the least cost. The average layman's knowledge of insurance makes him or her an easy prey to exaggerated statements and sometimes false promises. Before you decide on this very important purchase, listen to the advice of your A.A.N.A.

On September 17, 1955, the National Board of Trustees adopted and approved the Financial Security Program. Many plans, policies and companies were checked and double checked before final adoption. It was the *mass buying power* of the Association that induced the insurance companies to offer the finest protection at a minimum cost.

Recently, these group plans have been made available to Student Members. The continuation of these plans are predicated upon active membership. The Student Members will receive an invitation to participate from National Headquarters upon completion of the required course. During the latter months of the course in anesthesia, the student member will have an opportunity to apply for insurance to become effective immediately upon graduation.

The Financial Security Program includes the finest Professional and Personal Liability Group Plan, a comprehensive Accident and Sickness Group Plan, and an excellent Retirement Plan. Full information will be sent to the Student Members.

We suggest that all Student Members withhold the purchase of any individual plan of Insurance until they have had an opportunity to check into the A.A.N.A. Group programs.

Actually, under any of these Group Plans, the Student Members will save more on insurance premiums than on the cost of dues.

We welcome the opportunity to join with the other services now extending their help to all the Student Members.

The student members who are still in the schools of anesthesia may send a preliminary inquiry concerning any phase of the financial security program in which they are interested. By contacting the insurance company early all preliminaries can be completed so the insurance will become effective immediately upon graduation. Send inquiries marked "insurance" to the American Association of Nurse Anesthetists' Office, Prudential Plaza, Chicago 1, Illinois. The application on the opposite page may be used for one form of the insurance.

John Maginnis
Insurance Consultant

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	56-60	16.50	31.35	59.40
	61-65	19.80	37.60	71.30
( ) **PLAN B** $150 MONTHLY BENEFIT	16-55	19.80	37.60	71.30
	56-60	24.75	47.00	89.10
	61-65	29.75	56.45	107.15
( ) **PLAN C** $200 MONTHLY BENEFIT	16-55	26.40	50.20	95.00
	56-60	33.00	62.70	118.80
	61-65	39.60	75.20	142.60

IMPORTANT! Members earning less than $2,500 may enroll in Plan A only.

Members earning $2,500 or more may enroll in Plan A or B.
Members earning $3,000 or more may enroll in Plans A, B or C.

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Ages 16-55	$5.55	$10.55	$19.50
Ages 56-60	6.95	13.20	25.05
Ages 61-65	8.30	15.80	29.90

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Form 2186—Rev. 56

Legislation

Emanuel Hayt, LLB., Counsel A.A.N.A.

Physicians Exculpated On Explaining Gauze In Abdominal Cavity Was Unavoidable Accident—Plaintiff underwent an exploratory operation for a large abdominal abscess. In the course of this operation a large gauze mesh, measuring approximately 7 x 6 by about 3½ inches, was found in the abscess. Plaintiff charged that defendants, her attending physicians during a child delivery two years before, were negligent in permitting gauze to become lodged and embedded in her abdominal cavity. Plaintiff relied on the doctrine of res ipsa loquitur. A trial to a jury resulted in a judgment for defendants. On appeal plaintiff contended that defendants' evidence did not rebut her prima facie showing of negligence. This court held that the verdict and judgment were not without the support of substantial evidence. Defendants' evidence showed that, because of a sudden drop in the rapidity of heart beats of her undelivered baby, an immediate delivery became necessary. Because of the position of the unborn child, an episiotomy or incision to widen the vaginal canal became necessary. Shortly after the delivery had been completed, plaintiff suffered a severe hemorrhage. There was a grave fear that plaintiff was entering irreversible shock and would die. Confronted with this situation defendants determined to pack plaintiff's uterus and vagina with rolls of gauze. By this procedure plaintiff's hemorrhage was arrested. The court was of the view that, in the final analysis, the matter was one for the jury to determine. While the doctrine of res ipsa loquitur may have been applicable in the first instance, there was evidence of due care, both explaining the occurrence and rebutting the inference of negligence. Defendants satisfactorily explained the situation and exculpated themselves of negligence. The judgment for defendants was affirmed.

(Landsberg v. Kolodny, 302 P. 2n 86 - Cal. App.)

Surgeon Entitled To Extend Scope Of Operation Of Patient Under Anesthesia—Civil action to recover damages for personal injuries resulting from an alleged unauthorized operation performed by the defendant, a surgeon.

The plaintiff consulted the defendant as a surgeon. He diagnosed her ailment as appendicitis and recommended an operation to which she agreed. During the operation the doctor discovered some enlarged cysts on her left ovary, and he punctured them. After the operation the plaintiff developed phlebitis in her leg. She testified that Doctor Parrott told her "that while he was puncturing this cyst in my left ovary that he had cut a blood vessel and caused me to have phlebitis and that those blood clots were what was causing the trouble."

She also testified that defendant told Dr. Tyndall, who was called in to examine her for her leg condition, "that while he was operating he punctured some cysts on my ovaries, and while puncturing the cyst on my left ovary he cut a blood vessel which caused me to bleed," to which Dr. Tyndall said, "Fountain, you have played hell."

The defendant recommended that the plaintiff go to Duke Hospital, and there is evidence he promised he would pay the bill. She also saw Dr. I. Ridgeway Trimble at Johns Hopkins, Baltimore. Dr. Trimble operated on her left leg and side "to try to correct the damage that was done."

Plaintiff had to undergo considerable pain and suffering on account of the phlebitis and still has some trouble with it.

At the conclusion of the testimony, the court, on motion of the defendant, entered judgment of involuntary nonsuit. Plaintiff excepted and appealed.

In the first place, where the conduct relied on rests upon judgment, opinion, or theory, such as in case of a surgeon performing an operation, the ordinary rules for determining negligence do not prevail. The reason is that when one who possesses the requisite skill and ability acts according to his best judgment and in a careful and prudent manner, he is not chargeable with negligence.

Furthermore, proof of error of judgment and nothing more will not suffice. And the defendant testified that the cysts he punctured were slightly less than an inch in diameter, and that he felt "that these cysts were large enough to be potentially dangerous . . ."

A judge or court may take judicial notice of any fact in the field of any particular science which is either so notoriously true as not to be the subject of reasonable dispute or is capable of demonstration by resort to readily accessible sources of indisputable accuracy. Judges may inform themselves as to such facts by reference to standard works on the subject.

Suffice it to say that among physicians, surgeons, and others who make it their business to know the physiology of the human body, it is an accepted fact that (1) phlebitis of the leg is caused by the inflammation of a vein in the leg, and (2) when the inflammation becomes acute, it may cause the formation of blood clots which produce thrombophlebitis.

Phlebitis is at times a postoperative or pregnancy complication. When it developes after an operation, its cause is the combination of the operative procedures, that is, the anesthesia, the shock of the operation, and the confinement to bed which, in combination, cause a slowing of the blood flow and dehydration of the blood, which produces inflammation, and the formation of blood clots which further block the flow of blood which causes a swelling of the leg, redness, and tenderness.

While the law of contracts is applied as between a patient and his physician or surgeon, when a person consults a physician or surgeon, seeking treatment for a physical ailment, real or apparent, and the physician or surgeon agrees to accept him as a patient, it does not create a contract in the sense that term is ordinarily used. Usually there is no specification or particularization as to what the physician shall do. The patient selects, and commits himself to the care of, the doctor because he is confident the doctor possesses the requisite skill and ability to treat—and will treat—his physical ailment and restore him to normal good health.

The physician, after diagnosing the ailment, prescribes the treatment or the medicine to be administered; but the patient is under no legal obligation to follow the physician's instructions. Thus it is apt and perhaps more exact to say it creates a status or relation rather than a contract. In any event, agreement imposes on the physician or surgeon the duty, in the treatment of the patient, to apply his skill and ability in a careful and prudent manner.

Prior to the advent of the modern hospital and before anesthesia had appeared on the horizon of the medical world, the courts formulated and applied a rule in respect to operations which may now be justly considered unreasonable and unrealistic. During the period when our common law was being formulated and applied, even a major operation was performed in the home of the patient, and the patient ordinarily was conscious, so that the physician could consult him in respect to conditions which required or made advisable an extension of the operation. And even if the shock of the operation rendered the patient unconscious, immediate members of his family were usually available. Hence the courts formulated the rule that any extension of the operation by the physician without the consent of the patient or someone authorized to speak for him constituted a battery or trespass upon the person of the patient for which the physician was liable for damages.

However, now that hospitals are available to most people in need of major surgery; anesthesia is in common use; operations are performed in the operating rooms of such hospitals while the patient is under the influence of an anesthetic; the surgeon is bedecked with operating gown, mask, and gloves; and the attending relatives, if any, are in some other part of the hospital, sometimes many floors away, the law is in a state of flux. More and more courts are beginning to realize that ordinarily a surgeon is employed to remedy conditions without any express limitation on his authority in respect thereto, and that in view of these conditions which make consent impractical, it is unreasonable to hold the physician to the exact operation—particularly when it is internal—that his preliminary examination indicated was necessary.

In major internal operations, both the patient and the surgeon know that the exact condition of the patient cannot be finally and definitely diagnosed until after the patient is completely anesthetized and the incision has been made. In such case the consent—in the absence of proof to the contrary—will be construed as general in nature and the surgeon may extend the operation to remedy any abnormal or diseased condition in the area of the original incision whenever he, in the exercise of his sound professional judgment, determines that correct surgical procedure dictates and requires such an extension of the operation originally contemplated. This rule applies when the patient is at the time incapable of giving consent, and no one with authority to consent for him is immediately available.

The court held that the plaintiff's testimony failed to make out a prima facie case for the jury and therefore affirmed the judgment of the lower court.

(Kennedy v. Parrott, 90 S.E. 2d 754, 243 N.C. 355)

Hospital Liable For Sponge Left In Patient By Surgeon And Nurse—The evidence showed that defendant operated a hospital to

which plaintiff was admitted for examination and treatment. He had no personal physician to attend him at the hospital, though he was a paying patient, and he was attended by several physicians who were on the resident staff of the hospital and had offices there to render necessary services to patients who had no private physician to attend them in the hospital. After examination by several of the doctors, plaintiff underwent a mastoid operation and later an abdominal operation was suggested. Plaintiff agreed that Dr. Schuler should perform the operation. The operation took place in the defendant's surgery rooms with all facilities and personnel furnished by defendant, including nurses and anesthetist. During the course of the abdominal operation, sponges were used. Usually the type of sponge used had a ring and tape attached to one end which was left outside the incision to prevent closing of the incision before removal of the sponge. However, the nurse of defendant who prepared for plaintiff's operation did not use this type of sponge. She provided and used sponges with no safety tape and ring attached. It is the custom and practice for the nurses to count the sponges which are taken into the surgery room. After the operation and before the incision is closed, the nurses again make a count of the sponges used and not used to see if they total the number brought in. The surgeon relies on the nurses for this sponge count. In the case at bar, Dr. Schuler made such inquiry about the sponges and was informed by the scrub nurse that the sponges were accounted for. Whereupon, the surgeon closed the incision. The nurse, however, had made a mistake. The sponges had not been correctly counted and a large one was left in plaintiff's abdomen. The abdominal operation was performed on November 16, 1954, but plaintiff did not recover as expected. He finally became desperately sick and returned to the hospital and on February 25, 1955, Dr. Schuler again performed an abdominal operation which disclosed a gangrenous intestine caused by the sponge. The surgeon had to remove about three feet of intestine. This court held on the basis of this statement of facts that negligence was established beyond doubt. The question before the court was whether defendant can be held liable for the negligence of the surgeon and the nurse. If there is material evidence in the record to support a finding by the jury that Dr. Schuler was an agent of defendant at the time he performed the operation, defendant is liable for damages to plaintiff for leaving the sponge in his body. On the evidence, the jury was justified in reaching the conclusion that the nurse was the agent of defendant and also that the doctor-surgeon was the agent of the defendant, for whose negligent acts the defendant is liable. The judgment of $15,000 was not excessive. The judgment for plaintiff was affirmed. (Rural Educational Ass'n., v. Bush, 6 CCH Neg. Cases 2d 902 - Tenn.)

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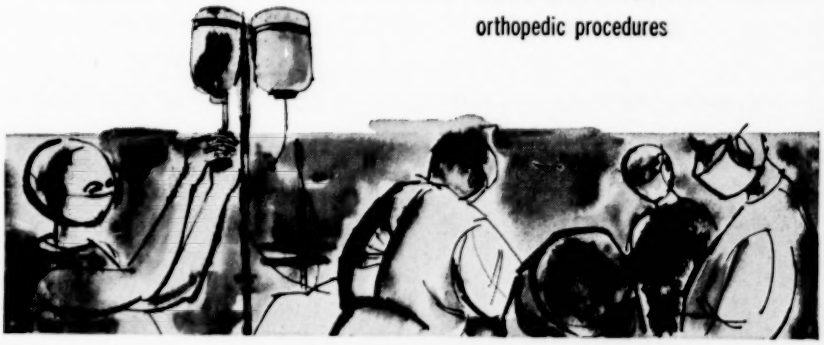

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Abstracts

GODDARD, R. F., AND ROORBACH, ELIZABETH H.: Intermittent positive-pressure breathing—aerosol therapy for asthma in children. J.A.M.A. 163:1125-1130 (March 30) 1957.

"Recent studies in intermittent positive-pressure breathing — aerosol therapy in children indicate that such therapy has been more effective in treatment of asthma in children than in adults by not only arresting the progress of the disease but also reversing the chronic changes due to edema, bronchospasm, and emphysema and promoting the restoration of normal pulmonary compliance and elasticity .... One hundred children, ranging in age from 1 to 17 years and suffering from varying degrees of asthma, have been treated by intermittent positive-pressure breathing—aerosol therapy during the past four years [at the Lovelace Clinic, Albuquerque, New Mexico] .....

"In our series, 98% of children with asthma of varying degrees responded to intermittent positive-pressure breathing—aerosol therapy .... Evaluation of the improvement was based on subjective symptomatic and physical changes and objective routine laboratory and specific pulmonary function studies. Forty of the children had failed to respond to the usual methods of therapy, which were adequate for another 105 children with less severe asthma. In our experience, therefore, we believe intermittent positive-pressure breathing —aerosol therapy for treatment of asthma in children has proved to be an adjunctive, 'curative,' and prophylactic type of treatment."

ZOLL, P. M., LINENTHAL, A. J., GIBSON, WILLIAM, PAUL, M. H. AND NORMAN, LEONA R.: Termination of ventricular fibrillation in man by externally applied electrical countershock. New England J. Med. 254:727-732 (April 19) 1956.

"Ventricular fibrillation is usually a rapidly fatal arrhythmia that may occur in cardiac patients, in any patient under anesthesia and in drowning and electrocution .... This paper reports the successful termination of ventricular fibrillation in 4 patients by countershock applied externally across the closed chest and demonstrates that external countershock is an immediately effective, safe and clinically feasible procedure .... As with external resuscitation from ventricular standstill with the cardiac pacemaker, successful defibrillation depends on immediate recognition of the emergency and prompt application of the external defibrillator. Although external countershock can be applied easily and quickly, delays in its application constitute the major limitation of successful resuscitation .... Defibrillation may be followed by ventricular standstill or recurrent fibrillation, especially when associated with anoxia from prolonged circulatory arrest. It may then be necessary to apply an external cardiac pacemaker, to use the defibrillator repeatedly and to employ other resuscitative measures such as vasopressor agents and artificial respiration with oxygen."

WYANT, G. M.: Respiratory obstruction due to blood clot from bleeding bronchiectasis: a case report. Canad. Anaesth. Soc. J. 3:276-278 (July) 1956.

"Mrs. G. F., a white female, aged 25 years . . . was admitted to University Hospital [Saskatoon] on December 24, 1955, because of haemoptysis . . . . Operation was started 20 minutes after induction of anaesthesia. There was at that time no evidence of moist sounds in the tracheobronchial tree. The pleura was opened approximately 10 minutes after skin incision and 10 minutes later, during exploration, some few moist sounds were noted and repeated tracheobronchial toilet was carried out. One hour and fifteen minutes after induction of anaesthesia, tracheobronchial toilet revealed the presence of a little blood, but this did not seem to be excessive and was aspirated. However, 10 minutes later sudden almost complete respiratory obstruction occurred which lasted for close to 10 minutes during which time the pulse rate fell to about 60 and there was increasing cyanosis which eventually merged into a degree of pallor. Patency of the endotracheal tube having been ascertained and mechanical defects in the machine having been rapidly excluded as possible causes, repeated tracheobronchial toilet was vigorously continued and eventually it became possible to re-inflate the exposed upper left lobe; this was followed by some improvement in the patient's condition. It was suspected at that time that ventilation of the right lung was probably poor or absent, judging by the resistance in the breathing bag. By that time the pulse rate had risen to between 130 and 140; the blood pressure had remained pretty well stable throughout the episode of difficulty and thereafter. Tracheobronchial toilet was continued repeatedly while arrangements were made for bronchoscopy, but before they were complete the suction catheter was made to enter the right main stem bronchus and on its withdrawal a long clot, measuring approximately 5 inches, was removed. This clot did not seem to be new in its entirety but there was suspicion of some organization of at least part of it, with fresh clot surrounding it. Soon after removal of the clot, the patient's colour improved markedly and within half an hour her pulse rate had subsided to somewhere in the neighbourhood of 110, where it remained throughout . . . . The postoperative course was quite smooth on breathing exercises and postural drainage . . . . This case is reported in order to emphasize the need for protecting the opposite lung in all 'wet' cases, whether due to bronchiectasis, lung abscess, or bleeding, by such devices as a double lumen catheter, endobronchial blockers, or unilateral bronchial intubation."

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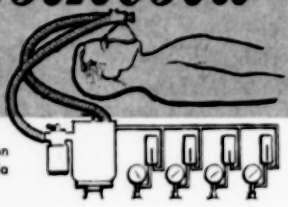


The Basis For Effective CO_2 Absorption

It has long been known that hydrated lime will absorb an acid gas such as CO_2, if the gas is held over the lime long enough. The first absorbers for anesthesia used hydrated lime water, but absorption was too slow to be practical.

In 1917, Dr. Robert E. Wilson discovered a method by which a small amount of caustic soda could be made to act as a "pump" to fill a large "reservoir" of hydrated lime with carbon dioxide. The product of his discovery is still known as Wilson Sodasorb.

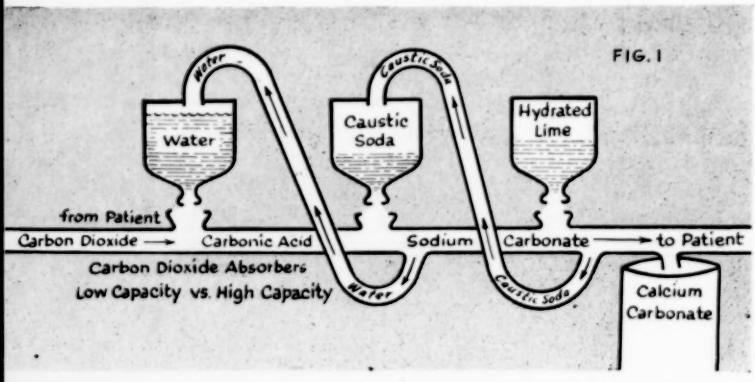
Sodasorb consists of three chemical compounds: water, caustic soda and hydrated lime. Carbon dioxide from the patient combines with the water in Sodasorb to form carbonic acid. This is why high-moisture Sodasorb is used in anesthesia machines. If soda lime has been exposed to air for long periods of time, moisture should be added when it is used in an anesthesia machine. If no water is present in Sodasorb, inefficient CO_2 absorption will occur for the first 15 - 20 minutes of breathing, until enough moisture from the patient has been picked up for an efficient chemical reaction.

In the absorption of carbon dioxide by Sodasorb (see Fig. 1) the carbon dioxide first reacts with the moisture in Sodasorb to form carbonic acid. The carbonic acid then reacts with the caustic soda (sodium hydroxide and potassium hydroxide) in Sodasorb to form sodium carbonate, potassium carbonate and water. These are very rapid reactions which enable the alkali to draw the acid gas out of the passing mixture and hold it.

In the third reaction, the sodium carbonate and potassium carbonate then react at leisure with the hydrated lime to form calcium carbonate, sodium hydroxide and potassium hydroxide.

The third reaction is a very slow process. Since the first two reactions are almost instantaneous, the supply of caustic soda is used up faster than it is regenerated. As the reservoir of hydrated lime fills up after sustained use, the chemical pump slows down because of the lack of caustic soda. Finally the pump works so slowly that it cannot feed carbon dioxide into the reservoir fast enough. Carbon dioxide then flows by and the soda lime is temporarily exhausted. This exhaustion can be corrected by allowing the soda lime to rest. During this rest, the third reaction continues at its slow pace, regenerating caustic soda until it will again absorb more CO_2.

In the search for more efficient absorbents, it was discovered that nothing could be done to speed up the third reaction. The amount of caustic soda predetermined the length of time the soda lime could be used. However, if the **rate of exposure** of the granule could be reduced by two-thirds, the first two reactions would be slowed down to the approximate rate of the third, producing a continuous "regeneration."



OHIO NO. 19 ABSORBER*

This theory is the basis for the design of the new Ohio No. 19 Absorber. By adding more mass (total cap. 2200 gms), and spreading the gas flow over the entire mass, each granule of soda lime is exposed to only one-third the rate of carbon dioxide as compared to the same granule in a conventional 700-gram canister. While capacity

can be increased by adding more absorbent, a point is reached where a further increase in mass will not result in a proportional increase in absorbent capacity. Since time is more important than maximum absorbent capacity, the No. 19 Absorber canister was designed to provide the greatest utilization of capacity in proportion to the mass of the absorbent. It is convenient to store, refill and handle. Clinical observations determined that the full charge of soda lime in the No. 19 Absorber would last 15-20 hours. Recent field reports have shown considerably longer life.

*No. 18 Absorber is the same as the No. 19 Absorber on the Series 1000 Cabinet Kinet-o-meter, but designed for use with the Ohio-Heidbrink stand and cart models.

Wall Effect

When soda lime is placed in a canister, one layer of the granules comes in contact with a flat wall surface. The open area between the granules and the wall is greater than the open area between adjacent granules. Because of this difference, the resistance along the wall of the canister is less than the resistance through the soda lime. Since gas follows the path of least resistance, a certain amount of gas always passes down the wall. This is known as the "wall effect."

On the No. 19 Absorber, the bottom screen is cone-shaped, so that the distance along the outside wall is longer than it is through the soda lime at the center of the canister. Resistance is a function of area and length of passage, so the "wall effect" is somewhat reduced. However, the greatest reduction of "wall effect" in this new model is due to less wall area as compared to total mass.

Because of "wall effect" a transparent canister is of little value in determining when soda lime should be replaced, since the color change will always take place along the wall first. Also, both glass and plastic are excellent insulators, increasing the temperature of the gas leaving the absorber. Glass and plastic are also nonconductors, and constitute an area where static charges may be created. Ohio absorbers use metal canisters to dissipate the heat and maintain conductive surfaces.

Reverse Flow

In the No. 19 Absorber, the gas flows through the down tube to the bottom of the canister and then upward through the soda lime. There are several advantages to this design. First, the gas passing down the tube is heated by the chemical reaction of the soda lime. The relative humidity is also reduced and water will not condense on the bottom of the canister or screen. The water vapor is carried up into the soda lime, eliminating the accumulation of moisture and calcium carbonate on the screen, both of which increase the resistance of the absorber. In fact, the bottom layers of lime are dry by the time the canister is ready to be recharged.

Intergranular Space

Because of the single chamber canister and larger capacity, the intergranular space has been greatly increased. Differences in moisture content and packing of soda lime can vary both the weight and intergranular space. The following figures apply to the No. 19 Absorber: Capacity 2,200 grams — Intergranular space 1,400 cc. Because of the large intergranular space, the gas is in contact with the soda lime for a longer period of time (approximately three inhalations).

Other Improvements

CANISTER CHANGE during anesthesia is accomplished without breaking the anesthetic circuit. When the control valve is turned to "off", the gas is directed across the head of the absorber, allowing canister to be removed.

NEW DIRECTION VALVES are housed in plastic domes for easy visibility. Light, rigid Formica discs seal on knife edge with less breathing resistance. New valve cage prevents sticking.

SIMPLE CANISTER ATTACHMENT has single, spring-loaded, self-centering screw.

DOWN TUBE AND SCREEN are easily removable for quick, convenient cleaning.

FILLING CAP, permanently fastened to divider, prevents filling the down tube with soda lime. Canister cannot be closed unless this cap is removed.

RELIEF VALVE is spring-loaded, with continuous range of 3 to 30 mm Hg and a full-closed position. Easily set for use with breathing machines that operate at pressures other than settings on weight-type relief valves.

THE STANDARD CIRCUIT has three advantages. Patient exhales directly into bag at low resistance. In assisted breathing, operator squeezes gas through soda lime, further assisting patient. Bag location is more convenient for assisted breathing. Ether vaporizer on inhalation side of circuit allows high concentrations of ether to be delivered to patient more rapidly.

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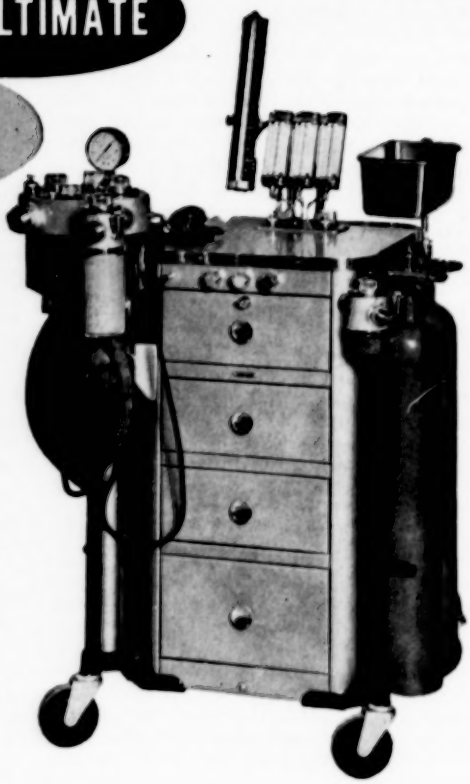

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Classified Advertisement

WANTED — Nurse Anesthetist for 242-bed hospital; salary open; 5 day week with no night call. Living accommodations for non-married anesthetist available at a nominal cost. Contact Administrator, Alexian Brothers Hospital, 1200 Belden Avenue, Chicago 14, Illinois.

Need two trained Nurse Anesthetists to work for a group of anesthesiologists in Northern Kentucky. Write or call for complete detailed printed information. Salary is more than $75.00 above national average. Anesthesia Associates, 301 E. 3rd Street, Newport, Kentucky. Telephone: Ax 1-6545.

REGISTERED NURSE ANESTHETISTS for 135-bed hospital, expanding to 185 beds. Work under qualified anesthesiologists. Charming small southern city. Excellent personnel policies. Apply: Director, John D. Archbold Memorial Hospital, Thomasville, Ga.

NURSE ANESTHETIST: 350-bed approved general hospital, 20 minutes from New York City. Salary $407 per month plus meals and laundry. Quarters available. 40 hour week, call duty one night per week $10 extra. Four weeks vacation and holidays. Large department headed by anesthesiologist. Write Box M-44, Journal American Association of Nurse Anesthetists, Prudential Plaza, Chicago 1, Illinois.

NURSE ANESTHETIST, A.A.N.A. member, to increase staff. New 330-bed hospital. Starting salary $450 per month. Rotating call; liberal personnel policies. Write: Dr. J. T. Atkins, Chief of Anesthesia, Baptist Memorial Hospital, 800 Miami Road, Jacksonville, Florida.

REGISTERED NURSE ANESTHETIST for 190-bed fully approved general hospital. Staff five nurse anesthetists, alternate call. Surgery and obstetrics. Three weeks paid vacation, six holidays, social security. $425 minimum salary, allowance for experience. Send resume of experience to Administrator, Baptist Hospital, Pensacola, Florida.

SECOND ANESTHETIST needed for modern air-conditioned, fully approved, 70-bed hospital in Southern Illinois, University town. Excellent working conditions. Salary open. Contact Jack Edmundson, Doctor's Hospital, Carbondale, Illinois.

NURSE ANESTHETIST — The Chicago Lying-in Hospital of the University of Chicago. Day Duty, 8:00 A.M. to 4:00 P.M.; Sunday off; no call; excellent fringe benefits; salary open. For further information contact Dr. P. Ouda Olson, 5841 Maryland Avenue, Chicago 37, Illinois.

ANESTHETIST: 345-bed voluntary general hospital — not tax supported. New modern air-conditioned surgical suite. Excellent working conditions. Live in or out. Six anesthetists on staff. Salary open. Apply: Decatur and Macon County Hospital, Decatur, Illinois.

NURSE ANESTHETIST: Immediate opening for four anesthetists to complete a staff of twelve for modern 382 bed general hospital with air-conditioned surgery. Salary commensurate with ability. Apply: John M. Willis, M.D., Director, Hamot Hospital, Erie, Pennsylvania.

NURSE ANESTHETIST for fully accredited, 115-bed hospital in Southwest Virginia. Air-conditioned operating rooms. Standard personnel policies and social security benefits. Salary $425.00 and maintenance allowance. Roy C. Brown, Administrator, Johnston Memorial Hospital, Abingdon, Virginia.

SECOND ANESTHETIST: 85-bed modern, fully accredited hospital. Good personnel policies. Salary $500. City of 25,000, border of Mexico, near mountains. Dry, mild all-year climate. Apply: Administrator, Memorial General Hospital, Las Cruces, New Mexico.

NURSE ANESTHETIST for 236-bed general hospital, 30 miles from New York City. Write, stating age, training and experience. Morristown Memorial Hospital, Morristown, New Jersey.

WANTED: Nurse Anesthetist for seventy-bed hospital in Tampa. Salary open. Write to Manuel Delgado, Superintendent, Centro Asturiano Hospital, Tampa, Florida.

WANTED: Nurse Anesthetist, member of AANA. 185-bed approved hospital. Salary open. Forty hour week; 3 weeks vacation, sick leave benefits and merit increases. Write or call for interview. Administrator, Blessing Hospital, Quincy, Illinois.

NURSE ANESTHETISTS (two) for expanding services of functionally modern general hospital. Separate anesthesia and recovery rooms. All types of surgery including neuro and chest. Air conditioned five-room suite. City of 95,000 in Michigan's resort area. Minimum starting salary $400 per month (five-day forty-hour week) in addition to attractive call compensation. Personnel Director, 705 Cooper Street, Saginaw, Michigan.

WANTED: a second anesthetist for modern 40-bed hospital; good working conditions, salary open. Contact Administrator, Rogers City Hospital, Rogers City, Michigan.

NURSE ANESTHETIST: Starting salary $415 per month for AANA members; $380 if eligible for membership. Annual increases plus laundry and private room with bath and telephone in new women's residence. Social Security and Pension Plan. 40 hour week including full time credit for first call. Second call paid for cases done. Six paid holidays, 30 days vacation annually and liberal sick leave policy. Apply: Marshall Kerry, M.D., Chief Anesthesiologist, The Reading Hospital, Reading, Pennsylvania.

WANTED: Nurse Anesthetist to join staff of five. Approved 200-bed hospital. Above average salary with extra pay for calls. Accumulated sick leave; 1 month vacation. Write to Jennie Cross, St. Luke's Hospital, Fargo, North Dakota.

REGISTERED NURSE ANESTHETIST: Excellent working conditions in modern 132-bed hospital. Friendly community with two colleges. Salary open pending qualifications and experience. Apply Ralph B. Bersell, Administrator, Passavant Memorial Area Hospital, Jacksonville, Illinois.

WANTED: Surgical anesthetist for 150-bed general hospital central Nebraska. Excellent working conditions and personnel policies. $450.00 per month to $550.00 per month and full maintenance. Apply: Box M-28, Journal American Association of Nurse Anesthetists, Prudential Plaza, Chicago 1, Illinois.

NURSE ANESTHETISTS (2). Modern, expanding fully accredited hospital in beautiful Cumberland Valley. College town of 18,000 population halfway between Philadelphia and Pittsburgh. 40 hour week, 10 days sick leave, 3 weeks vacation, living accommodations at nominal fee if desired. Diversified and congenial surgical staff. 8-bed recovery room. Start $375 per month. Automatic increments for 3 years — merit increments for next 3 years. Apply: F. J. O'Brien, Administrator, Chambersburg Hospital, Chambersburg, Pennsylvania.

NURSE ANESTHETISTS for 410-bed Florida Hospital. Salary range $4420 to $5564 annually, with on-call pay additional. Write: Administrator, Mound Park Hospital, St. Petersburg, Florida.

WANTED — Nurse Anesthetist, male or female. 100-bed hospital, Flathead Valley, 20 miles from Glacier Park. Apply: Administrator, Kalispell General Hospital conducted by the Sisters of Mercy, Kalispell, Montana.

NURSE ANESTHETIST for 61-bed general hospital located on the Eastern Shore of Maryland as second anesthetist in new surgical suite. $5,000 to $6,000 per year pending qualifications and experience. To begin duties June 1, 1957. Additional information from Administrator, Kent and Queen Anne's Hospital, Chestertown, Maryland.

LUTHERAN DEACONESS HOSPITAL, a 200-bed general hospital located on the near northwest side of Chicago, has openings for two anesthetists. For details write or call the Superintendent, Lutheran Deaconess Hospital, 1138 North Leavitt Street, Chicago 22, Illinois.

WANTED: Nurse Anesthetist for 1000-bed teaching hospital. Staff of 4 Anesthesiologists, 7 Residents and 8 Nurse Anesthetists. Salary range $4,920 to $6,144 annually with merit rating increases, 48 hour week, paid overtime, one month paid vacation, 15 days sick leave annually which can accumulate to 90 days; only emergency operations on Saturdays and Sundays. Please reply to Mrs. Geneva R. Watkins, Head Nurse Anesthetist, Anesthesia Department, Medical College of Virginia, Richmond 19, Virginia. State age, qualifications and school of anesthesia.

WANTED — NURSE ANESTHETIST to increase present staff. Salary new graduates begins $500.00, larger starting salary depending on experience. Meals while on duty, prepaid hospital and surgical benefits plus life insurance policy paid by employer. Write or call collect. Telephone 2-7455, Mr. C. W. Linville, Administrator, Olmsted County Community Hospital, Rochester, Minnesota.

PRINCIPAL ANESTHETIST, 182-bed general hospital, Hilo, Hawaii. Salary: Minimum $477 — Maximum $560. Apply to: Superintendent, Puumaile & Hilo Memorial Hospital, Hilo, Hawaii.

NURSE ANESTHETIST: 250-bed hospital for surgical and obstetrical anesthesia. $400-$450 per month, paid vacation. Group of 3 nurses and 4 physicians. Position open now. Apply: Administrator, St. Anthony's Hospital, 16th & Quitman, Denver, Colorado.

NURSE ANESTHETIST: 222-bed general hospital five minutes from heart of Honolulu; lovely island, ideal climate. Salary: $4320 to $5040. Apply to St. Francis Hospital, 2260 Liliha Street, Honolulu 17, Hawaii.

WANTED: Nurse Anesthetist, A.A.N.A. member. Position open now, to do free-lance anesthesia with other nurse anesthetist. Minimum salary $500 per month. Surgery and OB (about 30 OB cases per month). Call every other night and weekend. Well-equipped, 3-year old, 85-bed hospital furnishes machines and equipment. Apply Dr. Sharman — Dr. Clegg, 110 Helm Street, Elizabethtown, Kentucky.

WANTED: Nurse Anesthetist for 250 bed general hospital in Corpus Christi, Texas. Starting salary $450 with $10 monthly increases to $500. Six day week — call every third night. Two weeks paid vacation after one year. Social Security coverage. Present staff consists of two anesthesiologists and one nurse with additional part-time relief. Very active surgery including neurosurgery, chest and pediatric surgery. OB negligible. Excellent place to gain experience. Contact: Dr. R. J. Sigler, Box 5187, Corpus Christi, Texas.

NURSE ANESTHETISTS — 2 for 350-bed hospital increasing to 500 beds. 6 day work week. Starting salary $447.72 per month, 2 weeks vacation, 7 holidays, 10 days sick leave per year. Rotating shifts, no O.B. Apply: Harold Carron, M.D., Head of Anesthesia Department, Tampa General Hospital, Tampa 6, Florida.

TRAVEL EXPENSES for applicants selected for interview. Staff of 5 physicians, 7 nurses. Write: Department of Anesthesiology, University of Virginia, Charlottesville, Virginia.

ANESTHETIST (prefer male) for 115-bed general hospital expanding to 240 beds, 4 in department including anesthesiologist. Calls and weekends shared by four. Salary $500 per month beginning, 2 weeks vacation, sick leave, federal Social Security. City of 35,000 in center of scenic America, Utah Valley Hospital, Provo, Utah.

WANTED — male or female nurse anesthetist for 200-bed VA hospital. Salary range $4025 to $6390 depending on experience. Fifteen days sick leave and 30 days vacation a year. Retirement benefits. All types of surgery except obstetrics and pediatrics. Apply: Director, Anesthesia Service, VA Hospital, White River Junction, Vt.

THIRD ANESTHETIST needed to complete staff. New 90-bed hospital located in beautiful Blue Ridge Mountains, very near Washington, D. C. and New York City. Very friendly city of 16,000, centrally located to Midwest, East and South. Salary $450 for inexperienced, more for experienced. Conductive shoes and uniforms furnished. Worked holidays — time given off. Surgery usually completed by noon. Day off following call. Meals, excellent, at low cost. Contact: Mildred E. Sydnam, Head Anesthetist, Waynesboro Community Hospital, Waynesboro, Virginia.

ANESTHETIST for a modern hospital. Starting salary $450.00. Light surgery schedule, few O.B. cases. Please contact Mr. Charles Okey, Administrator, Weirton General Hospital, Weirton, West Virginia.

NURSE ANESTHETISTS to work with 5 anesthesiologists in community serving 70,000. Salary open. Apply to Wm. D. Maher, M.D., 307 S. 12th Avenue, Suite 7, Yakima, Washington.

POSITION OPEN for male or female Nurse Anesthetist, 100-bed general hospital, averaging 130 surgical and 75 OB cases per month. To rotate call with two other anesthetists. Salary $500 plus other benefits. Contact: Administrator, Memorial Hospital, Elizabethtown, Kentucky.

NURSE ANESTHETIST for 165-bed JCAH fully approved general hospital in southern Michigan. Annual vacations, 6 holidays, accumulative sick leave, social security. For experienced anesthetist salary will be $500 per month plus uniform laundry and meals while on duty. Extra pay for overtime and call duty. Apply: Administrator, W. A. Foote Hospital, Jackson, Mich.

WANTED — Nurse Anesthetist. 259-bed general hospital. Salary open, maintenance and meals supplied while on call. Monthly scheduling for on call and time off. Contact: A. T. Butt, Personnel Director, De Paul Hospital, Norfolk 5, Virginia.

NURSE ANESTHETISTS, AANA members, $400-$475 per month. 400-bed general hospital, excellent working conditions, liberal personnel policies. T.O., 16 anesthetists and 1 anesthesiologist. Write: Personnel Director, The Queen's Hospital, Honolulu, Hawaii.

NURSE ANESTHETISTS (Two) to complete staff of seven. M.D. Anesthesiologist in charge of Department. Salary from $441 up, depending on experience, New air-conditioned 310-bed general hospital. The Moses H. Cone Memorial Hospital, Greensboro, North Carolina.

NURSE ANESTHETIST: New 225-bed hospital. Excellent working conditions. Very good salary. Wonderful community living. Write: Robert L. Seifert, Personnel, Mercy Hospital, Johnstown, Pennsylvania.

NURSE ANESTHETIST: For 250-bed general hospital, air-conditioned operating and delivery rooms. 4 weeks paid vacation per year; 40 hour week; overtime paid on per diem basis. Department under direction of Medical Anesthesiologist. Salary open. Contact: Mr. Lynnard W. Herrington, Administrator, South Nassau Communities Hospital, Oceanside, L. I., N. Y.

Omission

In the Case Report, page 64, of the February 1957 JOURNAL, a line of the footnote was omitted. The footnote should have read:

"Figure 1.—A Constant Monitoring System. 1. Standard 'wrap around' type blood pressure cuff, 2. Chest piece type stethoscope from which diaphragm has been removed, and diaphragm retaining ring replaced, 3. Three-way Stopcock, 4. Chest piece type stethoscope, to affix to patient's chest, 5. Ear Defender® (Manufactured by Mine Safety Appliances Co., (Armed Forces Medical Stock List Catalog #6515-299-8288, etc.). The plastic tubing photographed is 'used' Venatube®; however, improvisations may be made here. (Official USAF Photo)"

The 26th Qualifying Examination will be held on November 9. The deadline for accepting completed applications and transcripts is October 7.

Future Anesthetists

(Continued from page 115)

freshed by continued education throughout her professional life.

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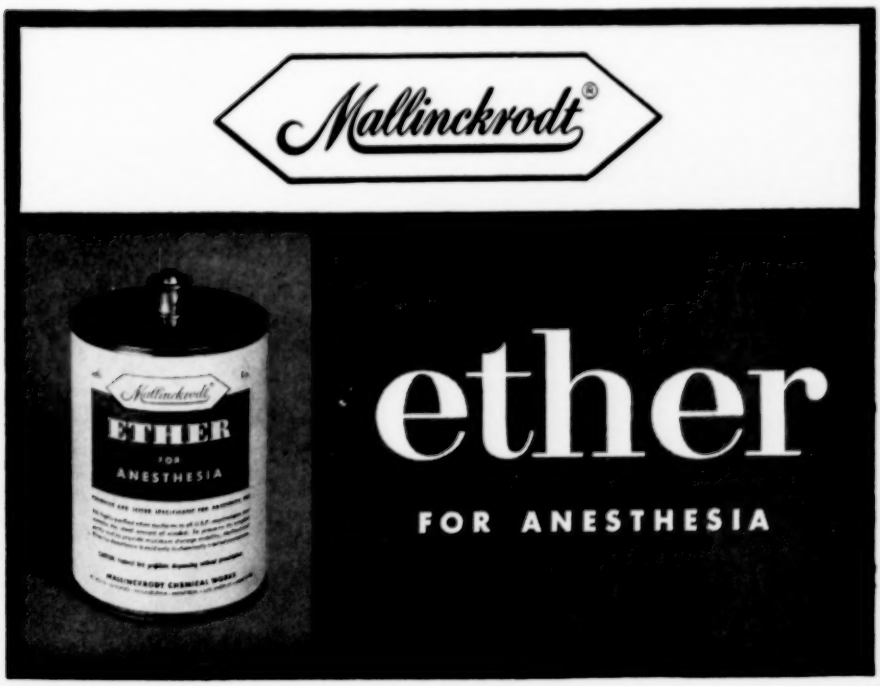
2. Compton, Jessie L., Bader, Marie N., Haas, Minnie V., and Lange, Agnes M.: Survey of Anesthesia Service - 1955. J. Am. A. Nurse Anesthetists **23**:223-235, Nov. 1955.



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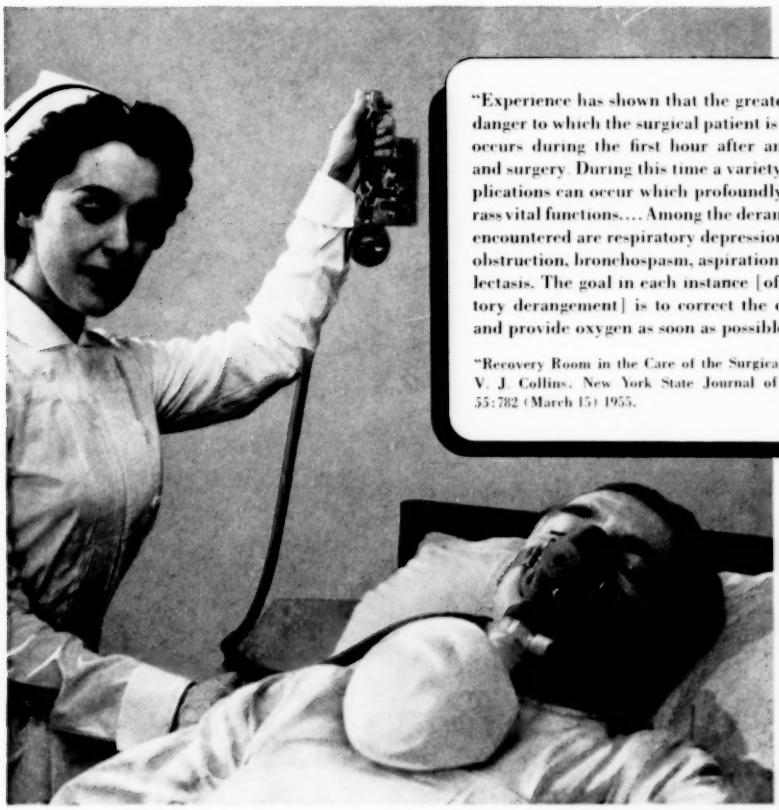
During postoperative recovery



"Experience has shown that the greatest acute danger to which the surgical patient is exposed occurs during the first hour after anesthesia and surgery. During this time a variety of complications can occur which profoundly embarrass vital functions.... Among the derangements encountered are respiratory depression, apnea, obstruction, bronchospasm, aspiration and atelectasis. The goal in each instance [of respiratory derangement] is to correct the difficulty and provide oxygen as soon as possible."

"Recovery Room in the Care of the Surgical Patient," V. J. Collins. New York State Journal of Medicine 55:782 (March 15) 1955.

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